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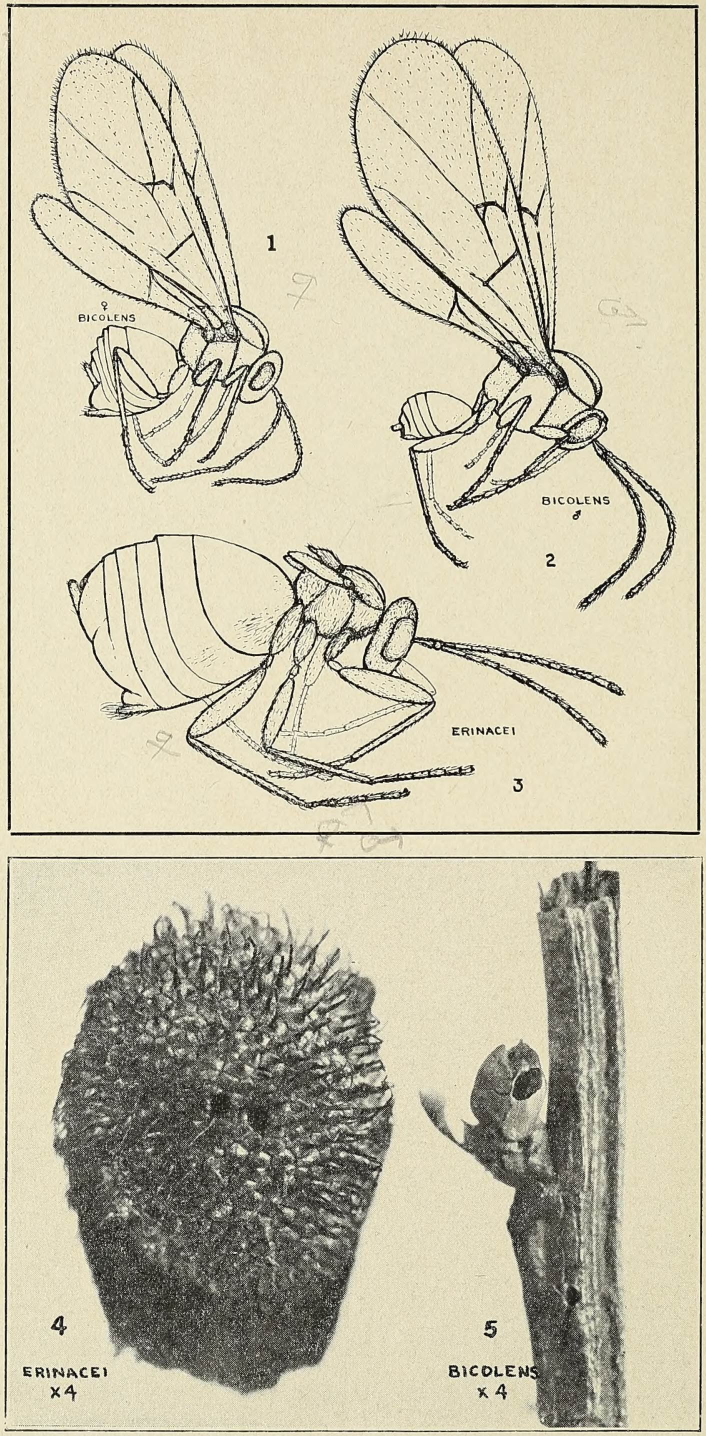

FIGS. 1-5. ALTERNATING GENERATIONS

An eastern American species, *Cynips (Acraspis) erinacei.* Figures 1, 2, 5 = bisexual form; 3, 4 = agamic form.

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The Gall Wasp Genus Cynips

A Study in the Origin of Species

By Alfred C. Kinsey, Professor of Zoölogy and Waterman Research Associate, Indiana University

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SUMMARY

THIS investigation was undertaken with the conviction that an intensive study of any group of species should contribute to the elucidation of biologic problems of general concern. Ninety-three species represented by more than 17,000 insects and 54,000 galls have been available for this analysis of the genus *Cynips* and these have offered an opportunity for studying the nature of species, individual variation, mutation and hybridization in nature, and the factors affecting the origin of species.

Species are defined as populations with common heredity. The thesis is maintained that species, in this sense, are more than mental concepts—that species are realities which preserve a morphologic and physiologic identity under varying conditions, over vast areas, and thru periods of time that may extend beyond the present geologic epoch. Within these populations individuals are found to vary, mutations to occur, and Mendelian races to develop as they are observed to develop in the laboratory. It appears that in *Cynips*, at least, these mutations have been the chief source of new species, but only when they are isolated from close relatives with which they might have interbred. Altho hybrid individuals prove common, and local colonies which have arisen by hybridization between related species are not unknown, the isolation of such hybrid populations to form species seems to have occurred in only a few instances in this genus.

The data on which these conclusions are based constitute a taxonomic revision of the genus *Cynips*. The group as redefined is a homogeneous unit delimited by insect morphology, gall characters, host relationships, life histories, and geographic distribution. Published records are coördinated with a large body of new data on these several aspects of the group. Of the 93 species placed in this genus, 45 have previously been described (only 26 of which have heretofore been recognized in *Cynips*) and 48 are new to science. To the 5 instances of alternation of generations which have previously been published for the group, 6 additional cases are added.

It should be of some moment to correlate these conclusions, concerning the nature and the origin of the species of *Cynips*, with the studies that have been made or remain to be made on the evolution of other groups of organisms.

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PART I. THE ORIGIN OF SPECIES

Among the diverse aspects of the so-called species problem, there is none that has received more unsatisfactory treatment than the study of species. The data of morphology and paleontology have given us information on the origin of orders and classes and phyla, and the geneticists and cytologists have contributed a brilliant interpretation of the mechanism which accounts for the similarities and, *ipso facto,* for the differences between individuals of successive generations; but comparative studies of species, first-hand contacts in the field with thousands of individuals of hundreds of related species, the careful examination of these individuals with modern laboratory facilities, and the correlation of such studies with the findings of genetics, cytology, and the other sciences—in short, the thoro taxonomic study of species has only occasionally been accomplished.

Our present account of the gall wasp genus *Cynips* is offered as an intensive study of 93 species of a phylogenetically natural group. It has been possible to translate so much of the story because the genus is a highly specialized unit of such recent (Oligocene or Miocene) origin that there are no serious gaps in the record as we find it today. The galls produced by these wasps are direct measures of one of the physiologic capacities of the insects, and thus afford an opportunity for the study of physiologic as well as morphologic variation within the group. The precise restriction of each species to particular hosts gives us an opportunity to analyze the relation of isolation to the origin of species, and the relatively poor means of locomotion of most of the gall wasps accounts for considerable geographic variation with its further emphasis on isolation. The existence of 42 subapterous forms in the genus has afforded an unexpected opportunity to show the relation of mutation to the origin of species. All of these items contribute to the utility of these insects for the study of the general problem of evolution. Whether species in the genus *Cynips* present a fair picture of species in general can

be determined only from further studies on other gall wasp genera and upon organisms of many diverse groups; but meanwhile we offer our data as illustrative of possibilities in the taxonomic method, and as a body of observations leading to what would seem to be unmistakable conclusions on the origin of species in this particular genus.

THE TAXONOMIC METHOD

THE attainment of sound ends in any field of science depends on certain common fundamentals of scientific method. An adequate understanding of any phenomenon must await repeated observations of that phenomenon thruout a wide range of specific cases, and an interpretation of the data based upon a comparative study of the groups in which that phenomenon is known to appear. It is only because the nature of the material studied and the categorical rank of the unit of comparison varies considerably with the problem under observation that we assign each biologic question to some special field, recognizing that each sub-science provides the best means of handling particular materials and particular categories.

To morphology, physiology, and psychology we make certain assignments not only because we wish to deal with particular aspects of the organic organization, but because these sciences are adapted for dealing with ordinarily few species which may be taken to stand as types of whole orders and classes or phyla of plants or animals. For this reason these sciences contribute data on such problems as the relationships of the larger groups, their appearance in the geologic record, and their value as evidence of the processes of evolution itself. In genetics, on the other hand, it is the individual which is the category chiefly concerned, and the correlations are made between individuals of experimentally proved hereditary relationships. In taxonomy the data are again individual organisms, but the comparisons employed are between such groups of individuals as constitute what we call species, and between all of the species for which we may find evidence of close, phylogenetic affinities. The unfolding of the complete record of evolution would thus appear to depend upon the coördination of the contributions from cytology, genetics, taxonomy, comparative anatomy, embryology, paleontology,

and still other fields less particularly concerned with the problem; and it is with this appreciation of the magnitude of the whole species problem that we hold a brief for the taxonomic method as fundamental to the elucidation of certain aspects of the subject.

I take it that the essential function of the taxonomic method is this interpretation of biologic phenomena by the comparison of related species. Whenever taxonomists increase their data (individuals studied) to a volume comparable with that on which the best research in other fields has been based, pursue their comparisons of related species as persistently as the geneticists have compared related generations of individuals, and strive towards interpretations of their data which shall be coördinated with the findings from other fields of biology, we shall have a taxonomic science that cannot fail to command the respect of students. If taxonomy has been in ill repute, it is because we have considered as our chief function the solution of something other than biologic problems. Too many systematists attain their objectives when each species is "represented" by a half-dozen specimens pinned in their cabinets. These are the systematists responsible for the definition of systematic entomology as the science of transferring pins from one box to another. If taxonomists have too often made species-descriptions and catalogs and nomenclatorial inanities the end of their efforts, it is no proof that the science cannot rise above its technic and concern itself with biologic problems. As my good friend has remarked, our difference is not with taxonomy but with taxonomists.

It is, then, as something of a defense that I detail the several items of the taxonomic method and give a specific accounting of the basis for the present analyses of species in the genus *Cynips*.

I should detail the taxonomic method in the following items:

1. The validation of data and conclusions by the utilization of large series of individuals of each species.
2. The utilization of series from wide-spread localities fairly representative of the range of each species.
3. The utilization of such material for every one of the species constituting the natural group under investigation.
4. The recognition of relationships between individuals and species by the consideration of every character which may be shown to have hereditary significance, to wit: morphologic structures of any and every

sort; such physiologic characteristics as can be shown to be hereditary and subject only to such environmental modifications as may be measurable; such special physiologic characteristics as are more often classified as psychologic, or as elements of "behavior"; and whatever other measure there may be of the physico-chemical organization which is the hereditary basis of the organism. This, in brief, demands a biologic as well as a structural basis for the recognition of species.

5. The special consideration of individual variation, with an attempt to analyze the hereditary or non-hereditary basis of the unusual characters. Many of the older workers made it a practice to throw their "exceptions" into the waste basket!

6. The accumulation of data with due scientific caution, and the further preservation of data in the form of labelled specimens, with the detailed citation of all such data in publication. In this admirable item of technic, taxonomy has been in advance of other fields of biology.

7. The classification of the species of the group to show every recognizable degree of phylogenetic affinities, the interpretation to be based on the above criteria for the recognition of relationships, upon host affinities (if available), the facts and known factors of geographic distribution, and correlation with the known geologic history of the area involved and the paleontologic history (if available) of the group and all closely related groups.

8. The interpretation of biologic phenomena within the group by an appeal to this phylogenetically established classification, to show the occasion and the order of evolutionary origin and the conditions of extension of the phenomena exhibited within the group.

9. The careful consideration and utilization of findings from other fields of scientific research at every step of the taxonomic investigation.

The above program is an ideal not always obtainable even with the best of modern facilities, albeit a standard by which the merit of a piece of taxonomic work may be adjudged. It demands the intensive treatment of such small groups of species as genera or families in contrast to the wider fields of interest of the older systematists. It calls for the so-called revisional treatment of genera instead of the miscellaneous species descriptions of long repute. It demands that phylogenetic units, instead of local faunas or floras, be the basis of taxonomic consideration. It demands that the taxonomist's rôle as the diagnostician of specimens emanating from enthusiastic collectors and hard-pressed economic entomologists be subordinated to the phylogenetic interpretation of biologic phenomena.

BASIS OF PRESENT STUDY

THE present study is based upon more than 17,000 insects and an estimated 54,000 galls—a total of over 71,000 specimens representing the 93 species known in the genus *Cynips*. Every one of the insects has been examined under the higher powers of a binocular microscope. Thousands of the specimens have been repeatedly re-examined in direct comparison with every specimen whose affinities might in any way throw light on the interpretation of the characters under observation. Exactly 16,899 of the insects and nearly all of the 54,000 galls of the genus are in our own collections where they have been available for all the comparisons and endless re-comparisons that have been necessary during the four years of intensive study given to this group of species. There are 96 Schmitt boxes of the mounted material of *Cynips* which constitute the permanent validation of our conclusions on this group, and this collection will be available at all times to future students. Part of our material is being distributed among museums and other workers on Cynipidae. Outside our own collections, I have studied the *Cynips* material in the American, U.S. National, Philadelphia Academy, Harvard (Museum of Comparative Zoölogy), Field, Illinois Natural History, and Stanford Museums.

The specific distribution of the material used in the present study is as follows:

Species	Insects Examined	Galls Examined
Agama (1 var.)	57	177
Arida (1 var.)	24	406
Bella (3 var.)	56	1,182
Cava (1 var.)	54	157
Centricola (4 var.)	118	245
Conica (1 var.)	3	38
Cornifex (1 var.)	4	12
Divisa (2 var.)	1,090	1,092
Disticha (1 var.)	13	5
Dugèsi (4 var.)	110	360
Echinus (6 var.)	589	6,460
Folii (4 var.)	646	935
Fulvicollis (7 var.)	5,170	14,581
Gemmula (4 var.)	746	547
Guadaloupensis (3 var.)	18	67
Hirta (7 var.)	1,457	5,240

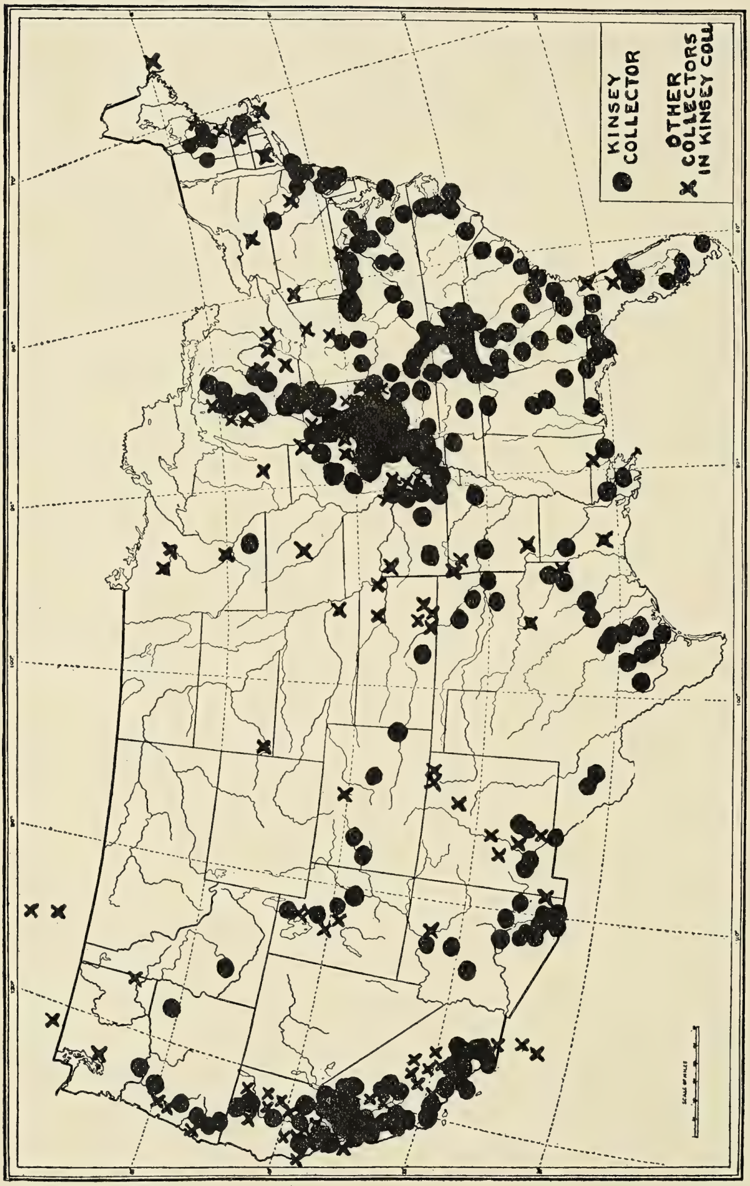

FIG 6. AMERICAN COLLECTIONS OF CYNIPS
Sources of material on which this study is based.

Species	Insects Examined	Galls Examined
Longiventris (2 var.)	129	355
Mirabilis (2 var.)	26	393
Maculosa (2 var.)	29	70
Mellea (11 var.)	431	1,010
Multipunctata (4 var.)	175	1,189
Nubila (3 var.)	64	186
Pezomachoides (8 var.)	5,890	18,135
Plumbea (1 var.)	30	38
Teres (3 var.)	55	180
Villosa (7 var.)	367	1,400
TOTALS—93 varieties	17,351 insects	54,460 galls

We should have had thousands of specimens of every one of these insects. Failing that, our conclusions on certain matters have been based to a large degree upon the more available species, and the intensive study of those species has offered interpretations of our smaller bodies of data which would not otherwise have been possible.

To obtain data on geographic distribution and the relation of geographic isolation to the origin of species, I have attempted to secure representative series of each *Cynips* from as many and as widely distributed localities as possible. It was in the fall of 1917 that I made my first collections of the genus, and in the twelve years that have intervened I have travelled over thirty-two thousand miles in the pursuance of the distributional data originating from my own collections. In 1919 and 1920 I went as a Sheldon Travelling Fellow of Harvard University to the South and to the Far West. For a number of years I have been relieved from part of my teaching to pursue research under a grant of the Waterman Institute of Indiana University, and in this connection I have engaged in extensive field work thruout the northern Middle West and in the southeastern quarter of the United States. In the course of these contacts with gall wasps in the field, as well as thru the longer hours spent over the microscope, I have gradually developed my present concept of species.

My own cross-country field work has been supplemented with collections made thru every season and in some cases for several years by collectors working in their native areas. Over a hundred such collectors have contributed data, sending material from localities in nearly every one of the United States

and from England, France, Germany, Denmark, Italy, Hungary, Austria, Czecho-Slovakia, Finland, and Russia among European countries. This coöperation has been indispensable, and specific acknowledgment of my indebtedness to each collector is made with each item in the systematic portion of this paper. The accompanying map (Fig. 6) will show the extensive—albeit still inadequate—sources of our American material of Cynipidae.

The accumulation of these geographic data has received some impetus from repeated analyses we have made of our field technic. By using the automobile we reach twice as much territory in a given time as we were formerly able to reach by railroad transportation. We find that the densest populations of Cynipidae are, for some reason not yet apparent to us, located on isolated oak trees or at edges of woodlands, and it is there that we now concentrate most of our efforts while in the field. It was some years before we learned that the distribution of most species of gall wasps is very local, and that it is a waste of time to attempt to make collections of populations that are sparsely scattered over the countryside. If large populations are not readily available at the first stopping place, we take a sample and move a hundred yards to a half-mile across country, continuing the procedure until we have discovered some tree or thicket heavily laden with galls. Many a rural community will bear witness to the peculiarities of our conduct in their countryside, but our cabinets of insects and galls bear more eloquent testimony to the effectiveness of this method.

Because of the peculiar host relations of the higher Cynipidae, it is necessary to collect from every species of oak in each locality in order to obtain a satisfactory set of specimens. To avoid being misled, in our interpretations of species, by such local populations as might segregate into Mendelian races, we make it a point to secure material from separated trees of each host wherever possible. Our returns are more than doubled when two of us work together in the field. We have given from a few hours to several days to the exploration of each locality, but upon careful accounting we find that, with two or more of us working together, we can take a fair sample of a region in four or five hours.

In order to secure approximate data on the furthest extension of the range of each species, we do not make our col-

lecting stations too near each other. Usually they are not less than fifty miles apart. In some instances it has been possible to revisit important regions and make further collections which would more precisely establish the limits of ranges, or give more extended data on the variation of species in transition areas. As already noted, this cross-country field work has been supplemented by year-round collections from many localities.

Since the coördination of taxonomic studies depends upon an accurate understanding of the Latin binomials that have been used for previously described species, I have made a thoro study of the holotypes—the single specimens which are absolute criteria of the correct application of each published name—for 76 out of the 78 American species of the genus. Practically all of these holotypes were studied after this study had advanced toward completion and when it was possible to make critical comparisons with my own material. Of the 15 European forms in this genus, I have seen types of four. The types of seven are not in existence, and the remaining five are established by types which I have not seen. Wherever I have not seen the types, the original descriptions are quoted in full in the systematic portion of this study.

Finally, among the material resources available for the present study mention should be made of the technical assistance and museum equipment that has been available for several years chiefly thru the interest of the Zoölogy Faculty and the Administration of Indiana University and grants elsewhere acknowledged from the Waterman Institute of Indiana University, from the Elizabeth Thompson Science Fund, and from the Bache Fund of the National Academy of Sciences.

These are the bases of the present study of the genus *Cynips*. This is our warrant for undertaking an interpretation of species in this group of insects. We offer no further extenuation of the fact that our conclusions are not in accord with systematic work that has been based on more meager material. We believe it no coincidence that our conclusions more nearly accord with those of Dunn who studied 12,600 specimens of the 86 forms of the salamanders of the family Plethodontidae, or of Mickel who studied approximately 10,000 specimens of the genus *Dasymutilla*. In handling even such large numbers of individuals of a limited group of spe-

cies, one becomes convinced that accurate information on the variability or constancy of species over wide areas, the extent of host and geographic isolation between related species, the correlation of biologic and structural facts, and the attainment of sound conclusions as to the affinities of species within any group and consequent interpretations of species and biologic phenomena cannot emanate from anything short of the most extensive data that modern facilities can provide.

THE SPECIES CONCEPT

THE earliest work of the systematists emphasized the similarities of individuals within species and the sharp distinctions between individuals of diverse species. This view was an inheritance from man's primitive knowledge of plants and animals, and one which, bolstered by a widespread misinterpretation of the doctrine of the uniformity of nature, is still widely held outside of scientific circles today.

As the facilities for the more careful examination of individuals were developed early in the last century, scientific emphasis was shifted to the fact that no two individuals are exactly alike, and the species problem resolved itself into a search for the factors of evolution. As a direct result of those investigations there has developed a growing conviction that individuals are the only realities in nature, and an agreement that species are only convenient concepts originating and ending in the minds of scientists. This is the basis of recent demands that we return to what is, curiously, called the Linnean species, it being argued that that was as near reality as any present-day concept, and an article far more ready for the use of those who are not taxonomic specialists. Taxonomists have contributed little to the resolution of this confusion, for many of them are bewildered at the array of geographic variants and transition zone hybrids which have recently become available particularly from our own continent, and species are frankly defined in the codes as concepts that may be standardized and established by quasi-legal verbiage.

One wonders to what extent this confusion as to the nature of species has delayed our understanding of the origin of species. Perhaps it is this confusion which leaves us without a convincing reply for the fundamentalists who insist that data from the evolution of domesticated plants and animals and from laboratory genetics may explain the origin of varieties but not of species. There is a peculiarly hollow ring to our statement that varieties are incipient species and that the evolution of species is too slow a process for human observation. Moreover, the illogical sequence in most of our texts, where the evolution materials are followed by the data of heredity, is some evidence that the geneticists do not perceive the application of their laboratory findings to species

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in nature; and such students as Bateson and Morgan have suggested that that application must be made by the taxonomists if (it is implied) the taxonomists ever become convinced that there are realities in nature that deserve to be called species.

Now, with these imputations of the unreality of species, I find myself no longer in accord. In the data that follow, evidence is presented that species are realities in nature more nearly satisfying the geneticist's concepts than the conventions of current taxonomy, and that the origins of such species are more satisfactorily explained on hereditary bases than by philosophic theories that may be invoked in extenuation of the fact and the factors of organic evolution.

We may begin our analysis of species by an examination of a few individuals taken in the field. We then become impressed with the truth of the assertion that no two individuals are exactly alike. And if we extend our investigations to several dozen individuals, we shall be confused by the varying characters that enter into any population which ordinarily passes as a species.

But if, on the other hand, we extend our examination to several hundred such individuals, we shall become impressed with another opinion, namely that there are many more points of uniformity than of variation among individuals taken from a given locality and habitat. Perhaps a half-dozen characters will show appreciable variation, while the hundreds of other characters that go to make up an organism are remarkably constant. One may believe that if larger series were more often utilized in taxonomic work the current bewilderment over variation would give way to a renewed respect for a certain uniformity that exists thruout such groups of individuals.

Again, the variation that may be observed in characters that do vary occurs within narrow limits. Thus, the antennal count in species of *Cynips* often varies by one, but among many thousands of individuals none has shown two segments more or less than any other individual in that species. The length of the wings in relation to the length of the body of any cynipid is not altogether an invariable item, but among the many measurements I have made this wing-body ratio is always within three or four per cent of the mean for the

species. In one species which constitutes an exception to this generalization, mutations are involved, and these will be treated in a later section of this paper.

Finally, the limits of variation of any character prove to be strikingly uniform thruout the great populations which we propose to call species. Whenever we have taken a reasonably large sample from any point over the usually considerable range of a species, the biometric data have not proved fundamentally different from data for any other fair sample from any other point in the range. The case of *Cynips erinacei* will serve to illustrate our experience. *Erinacei* is not only the most variable *Cynips* but one of the most variable cynipids I have examined. Reference to the descriptions in the systematic portion of this study will show that every one of the few characters which distinguish these insects from the most closely related species vary between limits approached by some one or another of the related species. The galls present more apparent variation, showing every gradation from smooth, naked, spherical, monothalamous structures (fig. 312) to densely spiny, ellipsoidal, polythalamous galls (fig. 315) which may have as many as eight larval cells. An initial experience with these extreme types of galls would lead one to believe they represented distinct species, and so they have always been classified heretofore. Increased material, however, has shown that every extreme and every one of the intermediate characters occurs thruout the range of *erinacei*.

The range of this species extends about 1,300 miles east and west and 450 miles north and south. We have samples of *erinacei* from nearly a hundred localities fairly well distributed over this tremendous area of possibly 500,000 square miles. In every large sample, *erinacei* is as variable as we have described it, and yet, after all, it is everywhere uniform —uniform in its constancy of variation. Even *erinacei* is, then, the sort of population which we would call a species.

Erinacei may present an extreme case, but it is not fundamentally different from the thing which one finds everywhere in nature. It is moreover, the picture of species to which our knowledge of mutation and Mendelian hybridization would lead us, and our definition of species must become genetic if we take into account the similarities and the differences which we find within a species. The essential uniformity of most

of the characters of individuals depends, of course, on their possession of common genes, originating from the accessibility thru interbreeding to common stocks of genes. The uniformity of the limits of variation within a species may be the result of similarly mutating genes, or of genes derived from hybridization with some exotic influence. Such hereditary property may become fairly well distributed in the course of time thruout any interbreeding population, and if the genes belong to groups of multiple factors controlling single characters in the organism, we have an explanation for the occurrence of every degree of variation between definite limits within a population. The other possible explanation of these common limits of variability is that similar genes may have not only the same potentialities but the same lack of potentialities, reaching similar limits to their capacities for directing the growth of the individual organism or to withstand the effects of environmental factors. As Bateson put it, the degree of variation of an organism may be inherited as much as its degree of uniformity.

We may, then, allow for all individual variation while defining species as populations with common heredity. The older definition of a species as a group of similar (implying nearly identical) individuals fails because of the amount of variability actually found in nature. Definitions of species as groups of individuals distinguished by a definite number of diagnostic characters, or by certain degrees of difference from other species lead to artificial concepts that take no adequate account of individual variation, Mendelian inheritance, hybridization, or mutation. The definition of species on the basis of their fertility or infertility does not delimit phylogenetic units, for while it is true that the individuals within a species must be mostly fertile *inter se* if they are to maintain any sort of hereditary relationship, the failure of distinct species to interbreed may be due to geographic or seasonal occurrence or to other factors not directly concerned with reproductive physiology. But if species are defined as populations with common heredity, we obtain a concept which seems genetically sound and which, we shall try to show, is a reality in nature.

An appreciation of the fact that species are great populations distinct from Mendelian races, local colonies, or the

preposterous Jordanon of botanical literature, may best be acquired by field experience with a group of related organisms. For illustration we may again utilize *Cynips erinacei* and some of its close relatives as they occur in the eastern portion of the United States.

We have already described *erinacei* as a highly variable species occurring on the leaves of the white oak, *Quercus alba,* over a tremendous area chiefly in the northern Middle West. On almost all of the infested trees at any locality in this area one may find a mixture of smooth and spiny galls of every extreme and intermediate type. Often all types of galls are crowded onto a single leaf, but occasionally a particular tree will have a preponderance of one type, and on several occasions we have found isolated trees well covered, as far as we could discover, with galls of only a single extreme type. These peculiar colonies, however, have always been on isolated trees or groups of trees, and they would appear to represent Mendelian races in which homozygosity in regard to particular characters had been affected by the isolation of the colony. Subsequent examinations of insects from such galls have failed to indicate that these local populations are homozygous in regard to any of the other characters that might vary within the species, and such colonies are passed by the taxonomist as ephemeral entities not satisfying the species concept.

If one will extend his collections in the first locality to a number of trees scattered over any appreciable distance—several hundred yards or a mile or two—he will leave the region with a sample that is as variable but as uniform as we have described it. If one travels to a second locality, five miles or fifty miles or a hundred and fifty miles from the first, the first collections may be duplicated. If one continues this procedure day after day, over the thousands of square miles which are the range of *erinacei,* one must become impressed with the fact that this is a population of inconceivably great numbers of individuals that are in certain aspects different and yet in an essential way similar over this tremendous territory. Of course, we can take only scant samples of the population, and we are reduced to glancing at most of the trees with their thousands of galls which we have no time to gather; or we fall to wondering how many inconceivable millions of individuals of *erinacei* there are on all the trees

in all the fields and woodlands and mountain forests thru which we journey at many miles an hour, for hour after hour, yesterday, today, and tomorrow. Nevertheless, our samples seem typical, for they are surprisingly uniform; and after such field experience, one comes to feel there is a reality summed up in the word "species" which is more than a few cabinet specimens or a bottle full of experimental material or a Latin binomial in a textbook. It is an existent, tremendous population of living individuals whose identities and dissimilarities, whose divergences from all other populations, whose origin in some remote past and extension thru actual generations and years of time, whose position on these particular trees in these particular valleys and everywhere over these miles of actual country—it is this reality which, to us, constitutes the species problem.

But we have met *erinacei* everywhere across the miles of Indiana and across Ohio. This morning we found it in the stream valleys and over the hillsides of West Virginia. At noon we still found it in more rugged country in the heart of the mountains, and now, near the end of the day, our road-signs read Maryland and we know we are near the crest of the Alleghanies. We get out of the car and climb the hillside. It is thick woodland and we find only stray galls now and again. They are smooth and naked specimens, for aught we can tell like the smooth galls of *erinacei*. A mile down the road we find an open meadow where two isolated trees offer promise of richer collections. The farm boy helps, and we collect more smooth galls while we wonder about the varied mixture which spreads so many miles back of us. It is drizzling now, and sheets of fine snow come whirling off the mountain, but we espy a tree in the next open, and in the gathering dusk find—many naked but only two spiny galls for our collections! We return to the car, wondering what is the matter with the sample.

Before we sleep that night we shall have worked our way down into the valley of the Potomac. On the next day we shall collect across the valley of the Shenandoah, and in the days that follow out onto the sand coast of Virginia and southward along the shores of the Carolinas. Within a few months we shall breed the insects from the smooth galls we gather, and then we shall know that from the Maryland line to the

coast we were dealing with *pezomachoides,* which is another species. At first the population was a mixture of insects of *erinacei* and *pezomachoides* and hybrids between, and it was only near the ocean that we found pure colonies of this new species, altho the typically smooth gall of *pezomachoides* was dominant to the western limits of the influence of the insect. But *pezomachoides,* altho very similar to *erinacei,* varies within limits that are different from those of *erinacei.* We shall find *pezomachoides* wherever we collect, until some day we turn in from the coast toward the heart of Georgia and meet a larger form of naked gall which will be *derivatus;* and then when we cross the southern front of the Blue Ridge and go into the Cumberlands we shall find the insect called *advena,* and in Kentucky it will be *ozark,* and in southern Indiana it will be *erinacei* again. In each area we shall find a population obviously related to every other, but each will constitute a population whose limits of variation are different from those of any other. Sometimes these limits overlap, sometimes they are wholly within, sometimes they are wholly without the limits for each other species. Sometimes the populations are wholly segregated by mountain crests and divides, sometimes the populations hybridize and intergrade over broad zones of transition; but always each population is distinct in a great area which is the heart of the range of each species. This is the picture which has gradually developed over the 32,000 miles, thru the 12 years during which we have pursued species.

And now, one confusion needs explanation before we are finished with this part of our discussion. It must be pointed out that there is a biologic concept called species and a taxonomic category called species, and that the two are not always synonymous. The concept we have developed is the biologic concept to which all except the taxonomists must refer whenever they consider the problem of species. This is the sense in which even taxonomists, including ourselves, intend the word when it is used in most biologic connections. But this biologic species is, unfortunately, the first of the taxonomic categories, the fundamental unit with taxonomic significance. As a category taxonomists may label this a geographic variant, a variety, a subspecies, or a species. There

is no uniformity in current practice, and the only attempts at uniformity have been based on purely artificial distinctions. The resolution of the terminology must take into account as a question of convenience that no category higher than the genus may be written into the nomenclature, and as a matter of fact that there are often three or four degrees of phylogenetic affinities which may be recognized below what seems to be best called a genus.

The ichthyologists believe that they have the solution in calling this lowest category a species and the second category a genus, thereby making their order the equivalent of many a genus among insects. I interpret the mammalogists to mean that they call a Mendelian race a variety, and the fundamental taxonomic unit a subspecies, which they imply is an incipient "species" (their next category). The botanists, as nearly as I can perceive, call their lowest unit either a variety or a species, depending upon its remoteness from the native heath of the botanist and his field of experience.

I am at a loss for a solution of this difficulty. It seems unreasonable to expect that this first category will ever be called anything but a species by biologists who are not systematists, and in that sense I shall use the word in general discussion in this study. It will be impossible to adopt this meaning in our system of classification without inventing a new name for a category between this and the genus, and I have not the temerity to propose such a name while taxonomists are as far removed from biologic realities as the codes of nomenclature and much current systematics would indicate. Consequently, in the systematic portion of this paper I have adopted the term variety for the category which, after all, fulfills the species concept. I can only plead that I am conscious of the inevitable confusion this involves, and desirous of making amends as soon as some one proposes a solution—but I shall look for a solution that will coördinate biologic concepts of species with questions of convenience in systematic botany and zoölogy.

MUTATIONS

THE most brilliant contribution to the species problem has been the outcome of transferring the search for the cause of variation into an investigation of the factors responsible for the uniformity of individuals of successive generations. Out of this development of modern genetics has come not only a localization in the reproductive cells of the mechanism by which hereditary similarities are achieved, but an assurance that the inception of new species must take place in those same genes and a considerable acquaintance with the potentialities of genes.

These laboratory studies have always led to the conclusion that changes in genes occur in sudden jumps, sometimes of small degree, sometimes of considerable size, but always as mutations which are complete as soon as they have occurred. This concept has been held in contrast with the neo-Darwinian conception of "fluctuating variations" which, by being accumulated over many generations and bent in a given direction by the force of natural selection, would gradually give rise to the characters of new species. Under this latter interpretation there may be *incipient* species of the sort conceived by many taxonomists in their definitions of varieties and subspecies; under the genetic interpretation the first mutant individual embodies all that the new species will contain, and is the new species as soon as it is given an opportunity to perpetuate its mutant characters thru a population of individuals.

The genetics data are conclusive as to the frequent occurence of mutations in the laboratory; there are numerous records of the appearance of similarly mutant individuals in nature, but there is little satisfactory evidence that these are the individuals out of which new species are made. Perhaps the best body of proof is that of Crampton's (1909-1928) on the development of geographically isolated races of snails from mutant stocks in various Pacific Islands. In the taxonomic literature there are a few other suggestions of similarly mutant origins of existent species, but such an experienced field worker as Chapman is quoted (H. F. Osborn, 1926) as finding among the birds next to no species which might be interpreted as owing their origin to mutation.

Osborn, it may be added, is in accord with this opinion of the minor importance of mutation. Bateson (1922) spoke for many of the geneticists when he expressed the same uncertainty of the application of the laboratory data to species in nature, and recently Anderson (1928) concludes a field and genetic study of two species of iris with the statement that there is little in his evidence to support the mutation theory of the origin of species.

Now, the problem of species obviously goes back to the recognition of the factors which may affect the potentialities of genes. I have nothing to contribute on this aspect of the subject. It is to an increased knowledge of the physico-chemical nature of protoplasm and of the gene, and to such experimental work as that of Muller and others on mutations affected by the introduction of measurable amounts of energy, that we must look for the explanation of the first step in the process of evolution. But granting that mutations do on occasion occur, we may present a body of new data to show that these laboratory mutants are precisely the materials which have differentiated many of the species of our genus *Cynips*.

This evidence becomes available because there are, in the family Cynipidae, more than 70 species of gall makers which have rudimentary or reduced wings strikingly different from the long wings normal among the other seven or eight hundred described species of the family. The differences between these two types of insects are illustrated on several of the plates accompanying this paper. Material on all of these 70 species will be brought together in a later study, but it may be said that all of the data support and extend that part which is here presented on the genus *Cynips*.

The typical wasp of the family Cynipidae has wings which are somewhat longer than its body. The wings even approach twice the body length (a wing-body ratio approaching 2.00) in certain genera of Cynipidae. The normal wings vary between the different genera and subgenera, but are remarkably constant among the individuals of each taxonomic group. Thus the normal ratio is always about 1.35 in the subgenus *Atrusca*, 1.50 in the subgenera *Besbicus* and *Cynips*, and 1.60 in the subgenus *Antron*. On the other hand, many Cynipidae have wings less than one-fifth the body length (ratios under

0.20), and there are species in which the wings are completely absent.

If taxonomic classifications may be taken as an expression of an author's conclusions on the evolutionary origins of his group, all previous workers have implied that the short-winged species represent genetic stocks separated from the long-winged species since the day that the first short-winged ancestor came into existence. The genera *Acraspis, Philonix, Xanthoteras, Xystoteras, Biorhiza, Parateras,* and others have been erected to receive the short-winged gall makers, and the long-winged species have been restricted to genera which contained nothing but long-winged species. It is the familiar story of evolution being conceivable as a function of the remote past, but unacceptable as a matter of moment in the affairs of the present. It is in essence implied that some great cataclysm once upon a time wrought one short-winged cynipid from which all the others have inherited, directly or thru more devious generic paths, all of their unusual characteristics.

There are more than wings to justify these existent classifications. Many of the short-winged species have certain reductions of thoracic characters, enlarged abdomens, often fused abdominal segments, and several other structural peculiarities not recognized among any long-winged species. Thus, the typical *Acraspis* has a blunt hypopygial spine (figs. 407-429) which is of uniform width for its whole length and terminated by a heavy tuft of hairs, and altho this structure occurs among all the other short-winged species which are *Acraspis,* this type of spine is not known in any long-winged cynipid. Similarly, the other short-winged genera have been based on groups of characters which would seem to establish their phylogenetic relationships.

Our first doubts of the existent interpretations were aroused when we reached our study of *Cynips clavuloides,* a common species on the Valley white oak, *Quercus lobata,* in central California. The typically long-winged agamic female *clavuloides* (fig. 164) develops in a leaf gall (fig. 142) which more or less resembles a minute Indian club in shape. The form is so distinctive that it naturally brought to mind the only very similar gall known at that time, Weld's species, *Xanthoteras teres.* Our previous studies (Kinsey 1920-1923)

had shown that gall structures are significant measures of an inherited physiologic capacity of these insects. Again, the gall of *teres* occurs on the leaves of a mountain form of the Oregon white oak *(Q. garryana semota)* in the southern Sierras adjacent to the Central Valley of California (fig. 28), and all of our experience with the distribution of species had lent support to a corollary of the so-called Jordan's Law, to the effect that the most closely related species occur in adjacent areas. But *teres* (fig. 162) was a flea-like insect with short wings not a quarter of the length of those of *clavuloides,* and it had been placed in a genus which contained none but short-winged species. Only the hypopygial spines of the two insects were similar (figs. 188, 190), but we had found that these spines are of great phylogenetic significance; and considering the spines, the galls, and the distribution data, the conclusion seemed inevitable that *clavuloides* and *teres* were close relatives.

As we have extended our study to other *Cynips,* we have repeatedly disclosed similar relationships between many other short-winged and long-winged species, until we are forced to believe that the genus includes 42 subapterous forms which have originated more or less directly from long-winged stocks within the genus. Our bases for the recognition of these affinities are:

1. Close identity of galls, as already explained;
2. Occurrence in adjacent ranges, as follows from Jordan's Law and from our other cynipid data;
3. Close taxonomic affinities between hosts of the insects;
4. Possession of similar hypopygial spines, tarsal claws, and antennal counts, altho we shall show in a later paragraph that dissimilar spines are not evidence of lack of relationships; and
5. Utilization of the bisexual form (where known) as more primitive than the agamic form in these insects (Kinsey 1920:369).

A few typical instances will illustrate our use of these bases. Turn first to the case of the long-winged *Cynips acraspiformis,* which Weld (1926) recognized as a good species of our present genus, altho he was puzzled to observe that it had a gall (fig. 304) similar to that of a short-winged *Acraspis!* The map (fig. 59) shows the range of this species. From its distribution and near identity in all structural characters, the closest relative of the long-winged *acraspiformis* is certainly the long-winged *expositor* (fig. 340) of eastern New Mexico

and West Texas. The gall of *expositor* (figs. 301-302) is only slightly different from that of *acraspiformis,* but the *expositor* gall is indistinguishable from that of *alaria* which occurs further to the north. One might collect from West Texas thru New Mexico and into Colorado without realizing he was collecting more than one species, and yet the insect of *alaria* (fig. 341) is subapterous and was described by Weld (1922) as a good *Acraspis.* The conclusion seems inevitable. The long-winged *acraspiformis* and *expositor,* and the short-winged *apache, alaria, calvescens,* and *villosa* are very close relatives, and the short-winged species must have originated directly from long-winged stocks which are still represented in the center of origin of the group (see pp. 66 to 67).

As another instance of the utilization of gall characters, we may cite the connection of the long-winged *Cynips nubila* with the short-winged *pezomachoides. Nubila,* occurring in the Southwest, produces a large, wool-coated gall (fig. 299) which is superficially as different from the small, naked, faceted gall of *pezomachoides* (fig. 312) as one might conceive. However, among the close relatives of *nubila* is the long-winged *acraspiformis* which we have just shown is close to the short-winged *alaria* and *villosa.* If reference is made to the figures of the details of gall structures of these species, one may find an interesting transition from the galls of the long-winged *nubila* (fig. 325), *expositor* (fig. 326), and *acraspiformis* (fig. 330) to the galls of the short-winged prinoides (fig. 327), *erinacei* (fig. 328 and 331) and *macrescens* (fig. 329). The last two of these are naked, faceted galls of the *pezomachoides* type. Further consideration of the plant tissues which enter into these gall structures (pp. 40 to 43) shows that the same elements are involved in all these galls, and that these elements are so developed nowhere but in the subgenus *Acraspis* of the genus *Cynips.* Thus even such superficially diverse galls as those of *nubila* and *pezomachoides* evidence the close affinities between short-winged and long-winged species of insects.

In another subgenus, *Cynips guadaloupensis, insolens,* and *patelloides* have moderately shortened wings. Weld considered these as species of *Acraspis,* altho he recognized that the galls are not typical for *Acraspis.* The three species occur on the canyon white oak *(Q. chrysolepis)* thruout the mountains of California. In the foothills, on the scrub white oaks

(*Q. dumosa, Q. durata,* etc.) and down in the valleys, on the Valley white oak *(Q. lobata)* there are numerous long-winged species, *echinus* (fig. 163), *schulthessae,* etc., which everyone will accept as typical *Cynips* of the subgenus *Antron.* But galls of *schulthessae* (figs. 151-153) and *patelloides* (figs. 144-145) are remarkably close, with similarities in internal structural details (figs. 192-193) which are infallible indicators of close relationships. The form of internal structure here involved is known nowhere else but in the subgenus *Antron.* Such gall structures, as well as the adjacent distributions of these species on related oaks, lead us to believe that *guadaloupensis* and *schulthessae* are close relatives in spite of their differences in wing characters.

There are a couple of cases of gall identities so thoroly guaranteeing the affinities of dissimilar insects that the systematists have already accepted them. These galls are the large, spherical, thin-shelled oak apples (figs. 262-263) which occur on the leaves of several species of white oaks in the Southwest. There are two stocks, *Cynips dugèsi* and *Cynips bella,* with seven described species in the area. The galls of all seven are identical, prolonged studies having failed to show any constant distinctions among them. One may collect galls from the foothills of southern Colorado or the mountains of northern New Mexico and Arizona or from West Texas into southern New Mexico and Arizona and into Central Mexico without finding evidence of more than one species. But upon breeding insects from these galls, each area is found to have distinct species, with fully winged insects in only a few of these areas. Three of the seven insects have wings which are from 15 to 37 per cent shorter than the normal for the subgenus. Weld (1926:18-19) recognized that the species *brevipennata* with shortened wings "replaced" a fully winged species in the more northern portion of the Southwest, but the contribution which these species offer to the problem of the origin of species needs further emphasis.

The original concept of *Acraspis* was based on the well-known, short-winged species *pezomachoides* and *erinacei* (fig. 3) of the eastern United States. All of the close relatives of *pezomachoides* are similarly short-winged insects in the agamic generation; but ever since Triggerson's studies (1914) of the life history of *Cynips pezomachoides erinacei* we should

have known what the long-winged ancestors of the group looked like. The experimentally proved bisexual generation of *erinacei* is an insect with fully developed wings (figs. 1-2), and other characters typical of long-winged *Cynips.* One can hardly agree with the literature in which these two generations have been placed in different genera. Both of them must represent true *Cynips.* Here is evidence that long-winged and short-winged species may be nearer than closely related species, for they may be alternate generations of one species.

In several of the cases cited above, we were delayed in our recognition of relationships by the peculiar hypopygial spines which, we have already mentioned, are found nowhere but among short-winged gall wasps. In connection with a generic re-arrangement which we are undertaking for the whole family Cynipidae, we have found that the hypopygial spine is one of the most constant of generic characters among the long-winged insects. This is confirmed by preliminary studies of more than five hundred species of Cynipidae, and the drawings for such long-winged subgenera as *Cynips, Besbicus,* and *Atrusca* in the present paper will illustrate our point. For this reason, we were at first reluctant to believe that short-winged *Acraspis* or short-winged *Philonix,* with distinctive spines, were not genera of nearly as ancient standing as previous classifications had indicated. On the other hand, there is one case of an insect, *apache,* which is obviously a short-winged *Acraspis* altho it, as far as we can determine from inadequate material, has the same spine (fig. 402) as the long-winged *Cynips acraspiformis* (fig. 400). Final evidence, however, is to be drawn from such a long-winged, bisexual generation as we have just described for *Cynips erinacei* where the short-winged agamic form has the peculiar spine (fig. 420) of a short-winged species of *Acraspis,* and the long-winged bisexual form has the typical spine (fig. 406) of a long-winged species of *Cynips.* One must conclude that the form of the spine, while thoroly diagnostic among long-winged Cynipidae, is liable to modification among short-winged forms.

In verification of these conclusions, an inverse application of our procedure was called for in the case of *Cynips fulvicollis* whose small, round, downy galls (fig. 228) are common everywhere in the northeastern sector of the United States.

Fulvicollis and its immediate relatives are short-winged insects (fig. 234) which we had concluded were *Cynips* of the subgenus *Philonix,* but no long-winged *Philonix* had been recognized among entomologists. But the bisexual insect, *Cynips pallipes,* came to our attention as a possible bisexual form of *fulvicollis* (for reasons given on p. 271), altho *pallipes* had a peculiar wing-body ratio of 1.17 not then recognized in any subgenus of *Cynips*, and a hypopygial spine (fig. 251) distinct from that of *fulvicollis* (fig. 252). There was only one other long-winged *Cynips* which we had not placed at that time in one of the six subgenera, and that was the agamic *C. plumbea* of the southwestern United States. Upon reexamination of the data, *plumbea* proved to have the same wing-body ratio and the same spine as *pallipes,* while the *gall* of the agamic *plumbea* (figs. 225-226) was hardly distinguishable except in color from the gall of the agamic *fulvicollis.* The peculiar spine of *fulvicollis* had to be taken as one more case of a modification accompanying wing reduction. Thru galls, alternate generations, wing-body ratios, and interpretations of reduced wings and transferred spines the data became interpretable without contradiction in any part.

For all of the 42 short-winged insects which we are considering as true *Cynips* there is this same coördination of the evidence. Our conclusions are summarized in the following table, where the style of indentation will indicate the phylogenetic affinities of each form, and the order will show the development from the more primitive to the more specialized members of each group. The number that follows each name shows the average wing-body ratio in that species. It will appear that there are at least 11 stocks of *Cynips* in which the subapterous condition must have arisen independently, and it is possible that a still larger number of the 42 subapterous species have arisen directly from long-winged ancestors.

Wing-lengths in Agamic Cynips

1. Subgenus **Cynips**	
folii	
folii	1.50
bisex. form	1.50
flosculi	1.50
bisex. form	1.50
ilicicola	....
atrifolii	1.50
longiventris	
longiventris	1.50
bisex. form	1.50
forsiusi	1.50
divisa	
divisa	1.50
bisex. form	1.50
atridivisa	1.50

agama 1.50
disticha 1.50
cornifex 1.50

2. Subgenus **Antron**

echinus
douglasii 1.60
bisex. form 1.30
echinus 1.60
bisex. form 1.30
vicina 1.60
bisex. form 1.30
dumosae 1.60
mista 1.60
schulthessae 1.60
bisex. form 1.30
guadaloupensis
guadaloupensis 0.62
insolens 0.80
patelloides 0.80
teres
clavuloides 1.60
hildebrandae 0.52
teres 0.36

3. Subgenus **Besbicus**

multipunctata
multipunctata 1.50
indicta 1.50
conspicua 1.50
heldae 1.50
maculosa
maculosa 1.50
tritior 1.50
mirabilis
leachii 1.50
mirabilis 1.50

4. Subgenus **Philonix**

plumbea 1.17
fulvicollis
rubricosa 0.38
vorisi 0.43
major 0.55
gigas 0.62
lanaeglobuli 0.65
fulvicollis 0.55
bisex. form 1.17
canadensis 0.40

5. Subgenus **Atrusca**

dugèsi
simulatrix 1.35
dugèsi 1.15
brevipennata 0.85
pupoides 0.90
bella
bella 1.35
congesta 1.35
vanescens 1.35
cava 1.15
centricola
centricola 1.35
clivorum 1.35
rubrae 1.35
strians 1.35

6. Subgenus **Acraspis**

arida 1.30
mellea
rydbergiana 1.30
unica 1.30
compta 1.30
anceps 1.30
bifurca 0.27-0.54
litigans 1.30
concolor 1.30
mellea 0.47
carolina 1.30
crassior 1.30
albicolens 1.30
conica 1.30
nubila
nubila 1.30
russa 1.30
incompta 1.30
villosa
acraspiformis 1.30
expositor 1.30
apache 0.70
alaria 0.32
calvescens 0.34
villosa 0.30
consocians 0.30
gemmula
cruenta 0.27
fuscata 0.27
suspecta 0.27

gemmula	0.27
bisex. form	1.30
pezomachoides	
cincturata	0.16
ozark	0.14
wheeleri	0.15
pezomachoides	0.23
derivatus	0.18
erinacei	0.22
bisex. form	1.30
advena	0.17-0.23
echinoides	0.19
hirta	
undulata	0.23
packorum	0.28
obtrectans	0.35
opima	0.26
scelesta	0.21
macrescens	0.21
hirta	0.23

It seems warranted to conclude that insects differing as thoroly as these long-winged and short-winged *Cynips* may be among the most closely related species in existence. Or, interpreting this statement, we may believe that diverse species may originate directly—that is, by direct mutation—from each other. It should be apparent to anyone familiar with the laboratory *Drosophila melanogaster* that these subapterous Cynipidae are quite comparable to the subapterous mutants which geneticists have shown to have arisen by direct mutation in the laboratory from long-winged *Drosophila* stock (e.g., see the summary publications of Morgan, Bridges, and Sturtevant cited in our bibliography). The explanation that will suffice for *Drosophila* will probably need no essential modification for the gall wasps, but the Cynipidae may establish the importance of the laboratory mutations as materials from which species populations actually arise.

Among none of the Cynipidae is there evidence that the modified wings have developed by the sort of fluctuating variation and the essentially orthogenetic selection conceived by the Neo-Darwinians. Altho there are many short-winged species which occur directly beside their long-winged relatives, there are no intermediate forms as we might expect from fluctuating variation, with the possible exception of *Cynips bifurca* which appears to be hybridizing today with the long-winged, parental stock.

There seems no basis for believing the shortened wings or any of the concomitant variations of any adaptive value to any of these insects. The short wings are not confined to warmer or colder climates, and long- and short-winged forms of various species are active at the same season in the same localities. The field data suggest nothing as to the survival value of these outstandingly basic modifications of structure.

The evidence is all in favor of believing that direct mutations have occurred as the result of modifications that must ultimately be explained in terms of the physics and the chemistry of genes.

A more detailed genetic interpretation of our material must for the most part be postponed for a later paper; but we may point out that the graded series of individuals, obtained when short-winged species hybridize with long-winged stocks as with *Cynips bifurca* and several species in other genera on which we shall publish later, indicate that wing characters in these insects may be dependent on multiple factors or perhaps on more than one group of such factors. It also appears possible that other structural peculiarities regularly associated with wing reduction may result from the same mutations of one or two genes in groups of linked genes responsible for wing characters. A single gene mutation in a single generation of insects might then give rise to a very distinct cynipid. Such radically new species are usually placed in distinct genera, and this probably explains why systematists have so often failed to believe that mutation accounts for the origin of species in nature. When the mutations are slight, they pass as products of Darwinian variation. There is, apparently, need of a revision of taxonomic procedure in the light of genetics data.

In conclusion, attention should be drawn to the interesting case of *Cynips bifurca,* a variable-winged species which we have from only two localities, one in southern Mississippi and one in southern Georgia. Both of these stations, however, are located well within the range of *Cynips anceps* (fig. 50). The galls of *bifurca* and *anceps* are identical (figs. 294-295). The insects have the same hypopygial spine (figs. 389-390), and a peculiar tarsal claw (fig. 350) found nowhere else in the genus except among a few of the close relatives of *anceps.* The figures of the wings (figs. 357-360) and of the whole insects of *bifurca* (figs. 338-339) will show that there are two distinct types of wings involved: one which is uniformly reduced, and the other a truncate wing more like the laboratory mutants called "truncate" in *Drosophila.* The significant thing about the *bifurca* series is the occurrence of intermediate individuals with wing-body ratios ranging between 0.27 and 0.54, body lengths varying from 2.2 to 3.3 mm., and

body color from entirely yellow-rufous in the smaller specimens to darker rufous with some black in the larger specimens. These larger individuals bear a striking resemblance in their wing venation (as far as it is present), body proportions, and much of their color to the still larger insects which are *anceps* (fig. 337). It is my suggestion that *bifurca* is the result of recent mutation or mutations which have hybridized with the parental *anceps* stocks. If the wing characters are actually controlled by multiple factors, we should expect the hybrids to form this sort of graded series. The occurrence of the colonies of *bifurca* well within the heart of the range of *anceps*, and the limited extent of these colonies seem indicators of their comparatively recent origins. *Bifurca* may be an instance of present-day mutation of the sort which, in the past, has given rise to the 42 short-winged species of *Cynips*.

PHYSIOLOGIC SPECIES

THE mutations that will always attract first attention involve such morphologic structures as we have considered in the previous section. On the other hand, there are three groups of physiologic characters in the genus *Cynips* which allow additional insight into the nature of species. These physiologic qualities are to be observed in the form of the gall, the life histories, and the host relations of these gall wasps.

The galls produced by the Cynipidae are, of course, plant tissue, but their form and structure depend largely upon the nature of the gall-producing stimulus which the insect puts into the plant. The precise source and nature of this stimulus is not known, but there seems every reason for believing that it partakes of the nature of an enzyme or hormone produced by some particular insect structure. To a limited extent the form of the gall does depend upon the plant tissue involved, for the possible transformations, as we have already pointed out (Kinsey 1923:21), are more restricted in certain tissues; but beyond that the form of the gall is dependent upon the species of the insect rather than upon the species of the plant. There must be nearly as many different kinds of gall-producing enzymes as there are species of gall wasps. When a single species of gall maker attacks more than one species of oak, the form of the gall is essentially the same on all of the hosts. This point has been so often established (e.g. Cook 1902, Kinsey 1920:365) that it is hardly necessary to accumulate more evidence. Nevertheless, the several cases in *Cynips* may be cited.

MULTIPLE HOSTS OF CYNIPS

C. maculosa tritior	on *Q. dumosa, Q. durata*
C. echinus douglasii	on *Q. lobata* (and *Q. Douglasii?*)
C. echinus dumosae	on *Q. dumosa, Q. turbinella*
C. echinus schulthessae	on *Q. dumosa, Q. durata*
C. teres hildebrandae	on *Q. dumosa, Q. durata*
C. plumbea	on *Q. arizonica, Q. oblongifolia, Q. Toumeyi*
C. fulvicollis vorisi	on *Q. macrocarpa, Q. bicolor*
C. fulvicollis major	on *Q. alba, Q. macrocarpa, Q. Michauxii*
C. fulvicollis gigas	on *Q. lyrata, Q. Mühlenbergii, Q. Michauxii*
C. fulvicollis fulvicollis	on *Q. alba, Q. Michauxii*

C. dugèsi simulatrix	on *Q. grisea, Q. undulata, Q. Gambelii, Q. arizonica, Q. oblongifolia*
C. dugèsi brevipennata	on *Q. grisea, Q. Gambelii, Q. fendleri*
C. bella bella	on *Q. grisea, Q. undulata, Q. pungens, Q. arizonica, Q. reticulata, Q. oblongifolia*
C. mellea anceps	on *Q. alba, Q. stellata, Q. floridana, Q. Chapmanii, Q. breviloba*
C. mellea bifurca	on *Q. stellata, Q. floridana*
C. mellea litigans	on *Q. stellata, Q. floridana*
C. mellea carolina	on *Q. alba, Q. stellata*
C. nubila nubila	on *Q. arizonica, Q. oblongifolia*
C. nubila russa	on *Q. arizonica, Q. oblongifolia*
C. nubila incompta	on *Q. reticulata, Q. glaucophylla*
C. villosa acraspiformis	on *Q. grisea, Q. undulata, Q. arizonica, Q. Toumeyi*
C. villosa expositor	on *Q. arizonica, Q. grisea*
C. villosa apache	on *Q. arizonica, Q. grisea*
C. gemmula fuscata	on *Q. Michauxii, Q. Mühlenbergii*
C. gemmula prinoides	on *Q. prinoides, Q. Mühlenbergii*
C. hirta hirta	on *Q. Prinus, Q. Michauxii*

It will be observed that in several cases a single species of *Cynips* occurs on such distinct oaks as *Quercus alba, Q. macrocarpa,* and *Q. Michauxii; Q. alba* and *Q. stellata;* etc. Such cases, commonly reported in literature on galls, are usually based on misdeterminations, but the present records have been carefully checked and may be verified from insect material in our collections.

Concerning the relative importance of insect and gall characters in the differentiation of species among *Cynips:*

52 species have insect structures more distinctive than galls,
24 species have galls more distinctive than insect structures,
17 species have galls and insects equally distinctive.

In more than half the genus the insects are more diagnostic than the galls, and there are even cases of distinct insects with practically identical galls. Most of these cases involve such closely related insects as we have called varieties in the systematic portion of this paper, but the following cases involve the second taxonomic category:

Cynips fulvicollis and *C. plumbea*
C. dugèsi and *C. bella*
C. pezomachoides and *C. gemmula* (certain var. only)
C. pezomachoides and *C. hirta* (certain var. only)
C. arida and *C. mellea*

More striking, however, are the species in this genus which are hardly distinguishable except by gall characters. It seems valid to recognize taxonomic groups based on such hereditary, physiologic characters if they involve large populations with distinct host relations and distinct geographic ranges. Nevertheless, current taxonomic studies are so often established upon morphologic bases that they would not recognize such species as the 24 physiologic *Cynips* listed above. In consequence we have seen much confusion of biologic data and serious invalidation of important conclusions.

Some of these physiologic species of *Cynips* deserve especial mention.

1. *Cynips maculosa* and *C. mirabilis* are hardly distinct insects, altho their galls (figs. 207-210) are very distinct. These two stocks have been separated since early in the history of the subgenus, but it is certain that most of their evolution has involved physiologic capacities of the insects.

2. Insects of *Cynips echinus echinus* and *C. echinus douglasii* seem absolutely indistinguishable. That the galls are very distinct is evident from figures 154-158.

3. Insects of *Cynips echinus schulthessae* and *C. echinus vicina* are very similar. A comparison of figures 151-153 and 156-158 will show how characteristic the galls of such species may be.

4. All of the European *Cynips* would certainly be considered three species on the basis of either the bisexual insects, the bisexual galls, or the agamic insects. The three would be *Cynips folii-longiventris, C. divisa-disticha-cornifex,* and *C. agama,* with the last not entirely distinct. I am convinced that without the distinctive galls (figs. 125-137) of the agamic forms of these insects they would never have been recognized as the six specific stocks which they really represent.

5. The insects of *Cynips nubila* appear identical with those of *C. russa.* The two galls (figs. 299-300) are alike in all respects except color. *Nubila* galls are wine-purple; those of *russa* are yellowish-russet. The first occurs in Arizona south of Tucson, the other north of Tucson (fig. 58). They occur on the same hosts (*Q. arizonica* and *Q. oblongifolia*), and occur within a few miles of each other at places in their ranges. The data do not warrant the admission of seasonal, climatic, or host factors as explanation of the differences in gall color. The two represent extensive populations existing in adjacent but distinct geographic areas, and must be considered as species. One of these species must have originated from the other by mutation as abrupt as that which gave rise to the short-winged species treated in the preceding section of this paper.

6. *Cynips multipunctata conspicua* and *C. multipunctata heldae* are hardly distinct insects, altho their galls are strikingly unlike in external form (see figs. 203 and 205-206). The close relations of the two are

attested by their identical hosts and adjacent ranges (fig. 31), as well as by their morphologic identities, and *heldae* seems to be a species derived by physiologic mutation from *conspicua* stock.

The phylogenetically ancient standing of the gall characters of these cynipids is evidenced in the internal structures of the deformations. The agamic galls of all of the species of the genus are produced on the veins of the leaves of white oak, with the single exception of *Cynips heldae,* which occurs either on leaf veins, petioles, or young stems of the oak. In most instances the galls appear on the under sides of the leaves. Beyerinck's figures of *Cynips folii* (re-drawn in our figs. 113-117) show the order of transformation of the normal fibrovascular tissue, and indicate something as to the plant elements involved. Other European students of gall histology have included species of *Cynips* in their investigations. There is the work of Lacaze-Duthiers (1850-1853), Fockeu (1889), Hieronymous (1890), Küster (1900, 1911) and Weidel (1911). Following the suggestion of Lacaze-Duthiers, all these workers have found four fundamental zones of tissue in most cynipid galls. These zones have been called the nutritive, protective, parenchyma, and epidermal layers, and in the degree and character of the development of each of these the European students have seen an essential uniformity of structure among the European species of *Cynips.*

Unfortunately, most of these histologic studies were made on three common European *Cynips: folii, longiventris,* and *divisa.* Only Weidel (1911) has given us a discerning study of *Cynips disticha* (fig. 123), and there he recognized five layers of tissue instead of the traditional four. My own studies of the gross anatomy of the galls of the entire genus *Cynips,* summarized in figures 117 to 124, lead me to believe that Weidel's five layers are the correct basis of homology in this genus.

If it is remembered that Beyerinck's studies (figs. 113-117) show that these leaf galls originate in the phloem of the fibrovascular bundle, from which they develop outwardly usually thru the lower epidermis of the leaf, the following interpretations will seem warranted:

1. Nutritive layer. The innermost tissue of the gall, lining the larval cell. A distinct layer in young galls of many species, soon becoming reduced by the feeding of the larval insect (and probably by ab-

sorption by the other plant tissues) to a thin, broken layer of shrunken, partially empty cells. Poorly developed in any but the very youngest galls of *Acraspis*. Possibly directly descended from phloem.

2. Protective layer. A sclerified tissue that is best developed in the European sub-genus of *Cynips*. The cell walls are thickened, and the cells may contain crystalline materials. The larval cell wall of most cynipid galls is largely made up of protective layer to which the remnants of the nutritive layer are attached on the inside and some spongy parenchyma tissue on the outside. The protective layer may be a direct development from sclerenchyma tissue in the vein. Apparently absent in *Acraspis*.

3. Spongy parenchyma. Occupying the central portion and constituting the major material in all the spongy and more hollow oak apple galls of this genus. Poorly developed in the subgenus *Antron* and absent, as far as I can see, from the galls of the subgenus *Acraspis*.

4. Collenchyma. Lying directly beneath the epidermis. A second layer in which the cells have thickened walls and usually crystalline contents. The layer appears hard and compact-crystalline to the naked eye. Practically absent (by an unfortunate coincidence) from the three species on which the first European studies were based, but present in most other species of that subgenus and in the other subgenera of *Cynips*. Constituting the bulk of the material in the galls of the subgenus *Acraspis*, and well-developed as the compact outer layer of *Antron*. Cook (1904) and Cosens (1914) treated this layer in certain species of *Acraspis* as modified parenchyma, but this seems to be an attempt to maintain the four layers of the European workers. This collenchyma layer in the gall may be developed from collenchyma to be found in a similar position in the normal leaf.

5. Epidermal layer. The outer covering of the gall, including the fairly normal epidermis and all of the abnormal developments from it. Largely naked or at the most with stellate hairs in most groups of *Cynips*. With a peculiarly faceted surface in many species of *Acraspis*, in some cases with each facet terminated by a unicellular process which may be spiny or long and wool-like. Obviously a modification of the normal leaf epidermis.

The precise homologies of these tissues must be made by some botanist using modern technic. It will be interesting to compare structures in galls of some of the species which occur either on upper and under surfaces of leaves, on veins, petioles, and (as in *heldae*) on young stems.

The distribution of the five types of gall tissues among the species of *Cynips* may be summarized as follows:

GALL STRUCTURES IN AGAMIC CYNIPS

O = absent, — = poorly developed, + = distinct, + + = well developed.

Subgenus	Specific Stock	Nutritive layer	Protective layer	Parenchyma layer	Collenchyma layer	Epidermal layer
Cynips	folii	+	+	+ +	0	+
	longiventris	+	+ +	+ +	—	+
	divisa	+	+ +	+ +	0	+
	agama	+	+	+ +	0	+
	disticha	+	+ +	+ +	+	+
	cornifex	+	+	+	+ +	+
Antron	echinus	+	+	—	+ +	+
	guadaloupensis	+	+	+ +	+	+
	teres	+	+	+	+ +	+
Besbicus	multipunctata	+	+	+	+	+
	maculosa	+	+	+	+	+
	mirabilis	+	+	+ +	+	+
Philonix	plumbea	+	+	+ +	—	+
	fulvicollis	+	+	+ +	—	+
Atrusca	dugèsi	+	+	+ +	+	+
	bella	+	+	+ +	+	+
	cava	+	+	+ +	+	+
	centricola	+	+	+ +	+	+
Acraspis	arida	—	+	+	+	+
	mellea	—	+	+	—	+
	conica	—	+	+	+	+
	nubila	—	0	0	+ +	+ +
	villosa	—	0	0	+ +	+ +
	gemmula	—	0	0	+ +	+ +
	pezomachoides	—	0	0	+ +	+ +
	hirta	—	0	0	+ +	+ +

Within each subgenus there is striking uniformity in the degree of development of each gall tissue. Thus, in the subgenus *Cynips* the protective layer is unusually thick and the collenchyma layer is absent or poorly developed (except in the unique *C. cornifex*). In *Antron* all five layers are well

developed, with a more pronounced development of the collenchyma layer. In *Besbicus* all five layers are again present (with the parenchyma most so in *mirabilis*). In *Philonix* the development is chiefly that of a rather solid spongy parenchyma. In *Atrusca* it is a parenchyma with few but tremendously extended fibers. In *Acraspis* all five layers are developed among the species centering about *Cynips mellea*, but in the other specific stocks in *Acraspis* the protective and parenchyma zones seem absent and the collenchyma and epidermal layers are unusually well developed.

The gall-producing stimulus, whatever its origin, is evidently selective in its effects upon particular plant tissues; and, since the gall characters are usually of subgeneric significance, it is apparent that these peculiarities of the gall-producing stimuli are of as ancient standing as any of the morphologic structures of the insects. This means that these physiologic qualities have been constant in heredity for possibly ten or twenty million years during which the specific stocks of *Cynips* have been differentiated.

The second body of data on the physiologic inheritance of species is concerned with life histories in *Cynips*. Like most of the other higher gall wasps, these insects have an alternation of a bisexual and an agamic generation. Thruout the groups the life history data are so uniform that it may be readily summarized.

The agamic insect develops in a gall which appears on the leaves early in the summer. The gall is mature by the end of the summer, and the insect matures and transforms into an adult early in the fall. Then—the most unique feature of the genus—the adult continues in the gall, chewing an exit passage thru everything except the epidermis of the structure, but not emerging until very late in the fall or some time in the winter. Most of the emergence is in mid-winter. The agamic females oviposit within the scales of unopened buds on the trees. The bisexual galls do not begin development until the leaves begin to unfold on the trees in the spring. These galls are simple, seed-like or bladdery, thin-shelled developments usually not larger than the buds within which they occur. The bisexual insects mature within three or four weeks, emerging in the middle of the spring. They copulate and oviposit in the main veins, usually on the under surfaces

of the unfolded but still immature leaves which are on the oaks at that season.

The constancy of this life history thruout nearly all of the genus *Cynips* is a remarkable testimonial to the hereditary stability of physiologic characters. This precise combination of characters is found nowhere else among the gall wasps. Its nearest approach is in the genus *Disholcaspis*, which is certainly a close relative of *Cynips*. But the agamic *Disholcaspis* emerges in the late fall, ovipositing in the veins of the embryonic leaves instead of in the bud scales; the bisexual *Disholcaspis* females do not emerge until mid-summer, and they oviposit in the bark of younger twigs of oak.

The life history of any cynipid is determined by a variety of physiologic characteristics of the insect. The date at which the adult matures depends both upon the season at which it started development and upon its rate of development. The place of oviposition of the female depends upon the inherent reflex and tropistic responses of the insect to factors which lead them to particular parts of particular species of plants and which inspire oviposition in those places. The length of the dormant period thru which each egg goes before it finally hatches must depend on the nature of the egg materials and on the reactions of those materials to external factors. In *Cynips* the eggs go thru a mid-winter dormancy of say 16 weeks before they hatch. The eggs of *Disholcaspis* require about 22 weeks. In each group the date of hatching is, however, a matter of long standing.

The mid-winter emergence of the agamic *Cynips* deserves further consideration. It is an interesting fact that we have bred most of our 17,000 insects of this genus out-of-doors at temperatures never more than perhaps fifteen degrees above freezing, and in many cases ten or fifteen degres (Fahrenheit) below freezing. When these agamic forms are at room temperature they emerge later than normally, if they emerge at all. Active insects brought indoors become more active for a few minutes, but soon they are killed by such stimulated activity.

The cause of mid-winter emergence is not satisfactorily explained, altho it has been generally accepted as inherent in some way within the species. Miss Payne's studies (1925-1926) on the behavior of insect tissues at low temperatures

explain some of our phenomena, but there is much need for precise measurements and bio-chemical investigations on our particular winter-active species. Concerning European *Cynips* Kieffer (1901:632) devoutly remarked of the insect which had delayed its emergence: "Ce qu'il attend, c'est l'époque que la Nature lui a assignée."

Whether the emergence date is determined by the response of the insect to environmental factors should be determinable by modifications of those factors. This experiment we have conducted on an extended scale, incidental to the breeding of *Cynips* material. We have brought 60 of the species of this genus from every type of remote locality to breed out-of-doors under the peculiar conditions of southern Indiana winters. We have bred material from northern Michigan and the mountains of northern California, from southern Georgia and the Gulf Coast, from southern California, Denmark, and more southern Europe. In many cases we have bred the same species for several winters, and in the case of *Cynips fulvicollis* (detailed later) we have had to keep transplanted material for two and three years outside our laboratory windows before the insects matured. Nevertheless, in all of this work, we have secured emergence at dates that would have been normal in the native habitats of the species. The season of emergence has been shown to be a specific quality which is not dependent upon the responses of the individual insects to immediate environmental conditions.

Northern Michigan material of *Cynips pezomachoides wheeleri*, due to emerge in northern Michigan during cold weather in late November and early December, emerged in southern Indiana at those same dates, altho at that season the temperatures are still very mild in our part of the country. Material of *Cynips pezomachoides pezomachoides* from near Boston, Massachusetts, emerged at Boston late in November and early in December at temperatures ten or fifteen degrees below freezing, while our material of apparently the same insect from the Carolinas, Georgia, and northern Florida emerged at the very same dates during mild weather in southern Indiana. We have had similar experience with several varieties of *Cynips fulvicollis* and still other species of the genus. The data for *fulvicollis* are:

Emergence of Cynips Fulvicollis

Variety	Source of Material	Chief Emergence Dates at Bloomington, Ind.
canadensis	No. Mich.	Late Nov., early Dec.
fulvicollis	So. Mich., no. Ind.	Early to late Dec.
	So. Ind., so. Ill.	Mid- to late Dec.
major	So. Ind., so. Ill., so. Mo.	Late Dec., early Jan.
vorisi	So. Kans.	Early Dec., to late Feb.

The most interesting aspect of *fulvicollis* is its earlier emergence in northern varieties and its later emergence in southern varieties. If, as our data show, the emergence date is not determined by direct response of the individual insects to environmental factors, then how may we explain this apparent correlation of emergence dates with the latitudinal range of each species? If Lamarckian effects enter here, they must come as the result of influences continued over numerous generations. Is it more probable that Darwinian selection has helped adjust these species to climatic conditions? Or is it possible that the apparent correlation is fortuitous?

All but two of the groups of species of *Cynips* complete their agamic lives within six to eight months. In *Cynips mellea* emergence is spread from the seventh to the tenth month (December thru March) with most of it in March. This is a departure from the ancestral tradition, but one specific for *mellea*. *Cynips fulvicollis* is a further departure, for most of its emergence is delayed until the eighteenth to twentieth month. This is particularly true of the more northern varieties of the species. The Kansas variety, *vorisi*, which is nearest the point of origin of the group, has the most normal life history, most of the individuals emerging during the first winter with only a few of them delaying emergence until the second season. The northern variety *canadensis* gives no emergence in the first year, most of it in the second year, and some stray emergence in the third year. The varieties ranging between *vorisi* and *canadensis* show a gradual shift from the one to the three-year cycle. It is an interesting case of new specific characters developing out of physiologic materials that have remained constant in other groups of *Cynips* for millions of years.

The third body of physiologic data bearing on the nature of species is to be drawn from the host relations of our present insects. Every species of the 93 in the genus occurs on white oaks, including, however, oaks of both the groups *Leucobalanus* and *Protobalanus* of the Trelease classification (1924). In common with many other Cynipidae, these insects thus throw doubt on the validity of separating *Protobalanus* from the other white oaks.

The restriction of our genus, as here classified, to the white oaks is of especial interest because previous monographs of the group (Dalla Torre 1893, Dalla Torre and Kieffer 1910, and Beutenmüller 1911) have included many black oak species. Here is an illustration of the importance of basing biologic conclusions on sound taxonomic classifications.

The most significant of the host relations of long phylogenetic standing within the genus may be summarized as follows:

1. The Pacific Coast subgenus *Besbicus* represents three stocks, *multipunctata, maculosa,* and *mirabilis,* which are restricted to the groups of oaks centering about *Q. lobata, Q. dumosa,* and *Q. garryana* respectively. The subgeneric stock must have reached the Sierras, where it split into the three stocks, before the Great Basin became arid during the Miocene. Today, every individual of all the species of this subgenus shows sensory reactions of essentially the same nature as those shown by the ancestral stocks many millions of years ago.
2. Similarly, the ancestral stocks of *Cynips echinus* and *C. guadaloupensis,* of the Pacific Coast, have perpetuated their host preferences, *Q. lobata-dumosa* and *Q. chrysolepis* respectively, thruout the 9 species which these groups now represent.
3. One of the most special host restrictions in this genus is that of the four species of the *Cynips centricola* group on *Q. stellata.* This evidences the persistence in heredity of a specialized physiologic character.
4. In the *Cynips mellea* group, 8 of the 11 species similarly occur on *Q. stellata.* In this case, however, one may find stray individuals on *Q. alba* and other hosts, especially in regions where *Q. stellata* is rare or lacking.
5. The species grouped under *Cynips pezomachoides* and *C. gemmula* are obviously very close relatives. Nevertheless, the seven species of *pezomachoides* east of the Great Plains are confined to *Q. alba* and its close relatives while the three species of *gemmula* occur on chestnut oaks of the *Q. Prinus* group. The ancestors of each group must have been separated on the basis of host preferences, and their descendents still maintain the ancestral choice.

It would appear, then, that species in nature may be differentiated wholly or largely either on physiologic or morphologic

bases, or equally on both bases; and it seems possible to recognize species of *Cynips* that have originated by physiologic as well as morphologic mutation. This seems reasonable, for organisms inherit their psychologic and physiologic characters in the same sense as they inherit their morphologic structures. As a matter of fact, the materials transmitted from one generation to the next are neither morphologic nor physiologic characters but an initial bit of simple protoplasm and a physico-chemical organization which will direct the activities of that protoplasm. Many outside, environmental factors also affect the developing organism, but the final form of the plant or animal is inherited in the sense that the inherited genes exert the primary influence on that form. It is in precisely the same sense that the physiologic or psychologic characters of species may be said to be inherited. There seems no sound basis for the oft-made suggestion that physiology is a function of structure—or structure of physiology. It would appear that both are products of the same protoplasm and are controlled by the same hereditary mechanism.

THE ISOLATION OF SPECIES

It now remains to show how such mutant races as we have noted in the preceding sections of this study may be transformed into such large and relatively uniform populations as satisfy our concepts of species.

A mutant individual is still far from constituting a species. Its survival depends in the first place upon the condition that the new, mutant characters shall not interfere with the health of the organism. To the lethal characters which the geneticists find linked with so many mutating genes in the laboratory there are added many other controlling conditions which would kill out a large proportion of our laboratory mutations if they were exposed to the rigors of existence in nature. This negative application of the theory of natural selection would seem axiomatic—tho I must reassert, along with Crampton (1928) and others, that this is the chief aspect of the Darwinian hypothesis which seems necessary to explain species as we have met them.

But allowing that a mutant is capable of existence, its greatest handicap is the fact that it usually develops in the midst of a population so similar to itself that it is capable of interbreeding and will interbreed with this parental stock. If the mutant characters involve only a single pair of genes and if they are dominant, they will gradually disturb the conspectus of the parental species which, in the course of considerable time, should thus become a new species in the territory formerly occupied by the parental stock. But, on the other hand, mutant characters in nature are probably recessive as often as they have proved in the laboratory (Morgan 1928:59-71), and there is increasing evidence that many characters involve multiple factors in heredity. In these events, the mutant has only a remote mathematic possibility of modifying the general aspect of the parental species, and in my judgment there is every probability that it will be submerged in the parental population. It becomes apparent that the transformation of a mutant race into a species must ordinarily depend upon some sort of isolating factor which will prevent its interbreeding with closely related stocks.

Now, this isolation of species, which we may postulate, is precisely the condition which we find among the most closely

HOST—GEOGRAPHIC ISOLATION OF CYNIPS

Subgeneric names: C = *Cynips*, An = *Antron*, B = *Besbicus*, P = *Philonix*, At = *Atrusca*, Ac = *Acraspis*.

	Q. ilex	Q. robur var.	Q. garryana	Q. Douglasii	Q. dumosa Q. durata et al.	Q. chrysolepis	Q. lobata	Q. Prinus Q. Michauxii, etc.	Q. alba, etc.	Q. lyrata Q. Mühlenbergii	Q. macrocarpa Q. bicolor	Q. stellata, etc.	Q. minima, etc.	Q. Gambelii, etc.	Q. grisea Q. arizonica, etc.	Q. undulata, etc.
Northern Europe		3C	(1 var. each, *C. folii*, *C. longiventris*, *C. divisa*)													
Central Europe		5C	(1 var. each, *C. folii*, *C. longiventris*, *C. divisa*, *C. agama*, *C. disticha*)													
Mediterranean	1C	2C														
Northern Pacific Coast			1B													
Northern California			1B, 1An	1B, 1An	1B, 2An	(1 var. each *Antron echinus*, *A. teres*)										
Central California				1 B, 1An	1B	1An	1B 1 B, 2An	(1 var. each, *Antron echinus*, *A. teres*)								
Southern California					1An	1An										
San Bernardino					1An											
San Jacinto						1An										
Canadian, Eastern U. S.								1Ac	1P, 1Ac		1Ac					
Northern Central U. S.			(1 var. each, *Acraspis hirta*, *A. gemmula*)					2Ac	1P, 1Ac		2Ac	(1 var. each, *Acraspis hirta*, *A. villosa*)				
Coastal Plain								1Ac	1Ac			1Ac, 1At				
Southern Central								1Ac	2Ac			1Ac, 1At				
Southern Highlands									1Ac			1Ac				
Florida										1Ac	1P	1Ac	1Ac			
Ozark Area									1P, 1Ac	1P	1P, 1Ac	1Ac, 1At				
Kansas-Oklahoma											1Ac					
East Texas									1P		1Ac	1Ac, 1At				
Central Texas												1Ac, 1At				
West Texas							(1 var. each, *Acraspis arida*, *A. villosa*, *Atrusca dugèsi*, *A. bella*)								2Ac, 2At	
Southern Rockies							(1 var. each, *Acraspis pezomachoides*, *A. hirta*, *A. villosa*)							3Ac, 1At	1Ac	1Ac
Southern Arizona-New Mexico							(1 var. each, *Acraspis nubila*, *A. villosa*, *Atrusca dugèsi*, *A. bella*)								2Ac, 2At, 1P	
Apache Trail										(1 var. each, *Acraspis villosa*, *A. conica*)					2Ac, 1At	
Utah										(1 var. each, *A. hirta*, *A. villosa*)				2Ac		
Central Mexico															1Ac, 1At	

related species in nature. The existence of widespread geographic isolation is attested in Dunn's work on salamanders, in Blanchard's studies of the king snakes, in Jordan's studies of fish, in the experience of many other students of mammals, birds, reptiles, and amphibia, in Gulick and Crampton's studies of snails, and in such work on plants as has extended beyond a single flora in a single geographic area. The importance of the host isolation of parasitic plants or animals is an outstanding feature of every study of such organisms. In addition every taxonomist knows that such items as seasonal occurrence, habitat, tropistic reactions, infertility, structural peculiarities, and many other such qualities of organisms are isolation factors which would account for the occurrence on occasion of more than one species of a given genetic stock in a given geographic area or on a given host. In spite of some contrary opinion (e.g. Nichols 1928), perhaps we are not unfair in summarizing taxonomic evidence as supporting a modified statement of the so-called Jordan's Law, to the effect that species in nature are always isolated from closely related species; and reflecting again on the genetic aspects of the situation one is inclined to postulate that before new species may come into existence or survive, the species *must* be isolated from the closely related species.

Further discussion of this question must be limited in this place to a presentation of the data on the host and geographic distribution of our 93 species of *Cynips*. The detailed records and maps for each of these species are given in the systematic portion of the study. These data seem to lead to the same conclusions which we framed (Kinsey 1923) for 63 species of the gall wasp genus *Neuroterus*. In each geographic area there is but a single species of any phylogenetic stock on any given host. The wide applicability of the rule should be evident from the summary of the host and distribution data which are given in the accompanying table, and the same data are more vividly portrayed on the phylogenetic maps which constitute figures 8 to 13.

With one possible exception *(C. bifurca)* every one of the 93 species of *Cynips* is in a host-geographic area distinct from that occupied by any other derivative of the same specific stock. In 59 of the cases the isolation extends back to the subgeneric stock. This is remarkable. If our conclusions on

the phylogenetic history of this genus are correct (see pp. 61 to 77) these subgenera have been separate since the Miocene, a matter of possibly ten to twenty million years. The subgenera originated in the Southwest, where the first subdivisions must have occurred. The extensions of these stocks out of the Southwest must have occurred before the Great Basin to the west or the Great Plains to the east became too arid to support an oak flora, which would suggest that it has been at least a million years since some of these stocks first came into their present host-geographic areas. The ranges of these species cover continuous instead of discontinuous regions, indicating that in all of that time no new species has succeeded in developing inside the range of any of these old species. This does not mean that the species have remained unchanged, for mutants developing in the old range and hybridizing with the parental types would remake the old species into new, hybrid species. But as for the multiplication of species, new populations can have developed only near the edge of an older range where they could spread into unoccupied territory away from the handicaps afforded by close relatives.

Another source of evidence that new species develop on the frontier of the parental range is afforded by the distribution of the short-winged species in *Cynips*. These insects are without doubt phylogenetically more recent than their closest long-winged relatives. Every one of the nine species which occur in southern Arizona and New Mexico, where these stocks first developed, is a long-winged species, just as the parental stocks undoubtedly were. The 42 short-winged species all lie more remote from the center of origin of the genus. Wherever long-winged and short-winged species exist in the same specific stock, the long-winged species are nearer and the short-winged species more remote from the Southwest. Thus, to cite specific instances, *Cynips dugèsi* has its only long-winged representative in southern Arizona and New Mexico, and shorter-winged representatives further north in the Rockies, eastward in West Texas and *(C. cava)* Central Texas, and southward in Central Mexico. *Cynips villosa* has its most southwestern varieties long-winged, with shorter-winged varieties occurring northward in Arizona, New Mexico, Colorado, and Utah, and eastward thru the Middle West. *Cynips mellea,* with ten varieties, spreads from the southwest across to

the Atlantic seaboard, retaining its long wings everywhere except in the most remote corner of its range, in the very southeastern corner of the United States, where it is now developing short-winged species.

There are a few further aspects of the distribution of *Cynips* which have some bearing on the problem of species.

1. The maps of the several species show that ranges vary from relatively small (e.g. the San Bernardino area of California and the Apache Trail area of Arizona) to very large (e.g. the whole of Central Europe or the northeastern quarter of the United States), but they more often involve areas of considerable size. This means that species are relatively stable entities which are not easily disturbed by mutations or immigrations of new stocks. If such new stocks are not submerged, interbreeding must proceed fast enough over these areas to maintain the uniformity of the species. It is difficult to conceive how this can occur in the largest of the areas.

2. The ranges of these species are more often large in the regions which are topographically most uniform. The relatively rugged Central European area is an exception to this rule. Nevertheless, the general condition indicates that the isolation afforded by topographically diverse areas may be a considerable factor in favoring the multiplication of species.

3. There are, on the other hand, areas of relatively uniform topography within which distinct species have been isolated. This is true of the Canadian, Coastal Plain, northern Middle West, southern Middle West, Ozark, east Texas, and Central Texas areas in the United States. None of these areas appears to be bounded in such a way as to furnish enough geographic factors to isolate species. Distance must be an isolating factor in the origin and propagation of species. This item is never listed among factors of distribution, but I am inclined to believe that in an area like the eastern United States it is one of the most important factors. Distance would act as a barrier by preventing an interchange of genes thruout a large population, thus favoring the development of local races.

4. Another fact showing the importance of isolation is the common occurrence of hybrid individuals in transition areas between species. These hybrid populations are so extensive in the more uniform, eastern two-thirds of the United

States that they are in part responsible for the widespread opinion that there are no species but highly variable complexes ranging over this part of this country. This opinion is not justified by our study of Cynipidae. In series of related species, east of the Rockies (figs. 37, 50, 59, 63, and 70), we do not find continuous gradations from one to the other end of the group, but first an area with a pure population, then an area of hybrid individuals, then another pure population, another transition population, and so on across the country. The ornithologists have ruled that the term species should be restricted to populations between which there are no intergradent individuals, and the term subspecies to populations between which such intergrades do exist. They imply that the presence or absence of hybrid individuals in the transition zones is a matter of phylogenetic significance. With this I cannot agree. To follow this rule, the ultimate phylogenetic unit (the species concept of biologists in general, the result of the most recent mutation which has been sufficiently isolated to give rise to pure populations) would usually rank as a species in the Far West. In the East populations originating in precisely the same way and representing the very same stage in phylogeny would be called subspecies.

5. The range of each species of *Cynips* coincides to a large degree with the range of every other species of *Cynips* of that part of the country. The maps thruout this paper will show the location of such concommitant ranges. These areas bear some resemblance to the life zones of current repute, but the ranges of no two species are precisely the same, and there are outstanding discrepancies (e.g. the range of *Cynips pezomachoides pezomachoides* vs. the range of *Cynips mellea carolina*). These generalized areas certainly bear no relation to the life zones hypothesized by C. Hart Merriam (1898) and since then propagated by the U.S. Biological Survey.

6. The data given in a later section of this paper on the phylogenetic history of *Cynips*, and summarized in our phylogenetic maps (figures 8-13) suggest that the location and shape of these generalized areas of distribution are in part a result of the place of origin and path of migration of each subgenus. If this is so, the picture may be different for each group of organisms, and it becomes doubtful how far these approximations to life zones in *Cynips* may be extended to other groups of organisms.

HYBRIDIZATION

ALTHO we have evidence that new species most often originate thru mutation and subsequent isolation, the possibility still remains that species may on occasion have hybrid origins. Mendelian hybrids in the midst of populations in which mutations have occurred have already been described in this paper (pp. 49, 53), with the suggestion that such hybrids are submerged, or that they give rise to local variations of the original population, or that they may after considerable time change the complexion of the old species and thus give rise to a new species. But the question is raised whether hybrid individuals originating from interspecific crosses may give rise to a third species without the replacement of either of the parental stocks.

Jeffrey's charge (1925-1928) that *Drosophila melanogaster* has had a hybrid origin pertains to the product of inter-specific hybridization; the geneticists have considered the criticism unimportant probably because they have in mind such Mendelian races or mutant individuals as may readily be admitted to have entered into the constitution of probably every species. The real issue is evidently that which Lotsy (1916), Jeffrey, and many others have had in mind, but the solution must depend upon a knowledge of hybrids and species in nature, as well as upon the more cryptic means which Jeffrey would employ.

Everyone who has studied a large group of closely related species in the field knows that hybrid individuals of apparently inter-specific origin are not uncommon in the transition areas that usually occur between related faunas and floras, especially in the relatively uniform eastern two-thirds of the United States. The recognition of these individuals as hybrids depends, of course, upon the recognition of combinations of characters typical of Mendelian heredity, and of such graded series as we would be led to expect from crosses in which many of the characters were controlled by multiple factors in heredity. Further than that, we may expect that hybrids will occur within or between the areas occupied by the two hybridizing species.

On the above bases, hybrid populations are recognizable among the Cynipidae of the northern half of the Lower Penin-

sula of Michigan; thruout most of New England south of the Androscoggin River; in the southern third of Indiana and the adjacent areas of southern Illinois; in the Southeast wherever the northern faunas of the Appalachians come into contact with southern species at lower elevations, particularly in the eastern two-thirds of Kentucky and in the Cumberlands and the lower hill country of central Tennessee; and farther west in more limited areas that lie between practically every one of the cynipid faunas all the way to the Pacific Coast. I have similar hybrid series in my European collections of *Cynips* from more northern Denmark, the southernmost portion of Finland, from Bohemia, and from the upper Danube valley.

In some of these localities, as for instance in the neighborhood of our own laboratory at Bloomington, Indiana, the hybrid individuals may constitute 30 to 50 per cent of each collection. In places in the Cumberlands of Tennessee the hybrids may amount to 80 per cent or more of the cynipid populations. Whether the areas of transition among the Cynipidae are the same as those among other organisms must be determined by studies on these other groups. Nevertheless, if Jordan's Law holds as often as it would appear, species usually have close relatives in adjacent areas, whatever group of plants or animals they represent, and such close relatives are usually fertile *inter se* and should give rise to inter-specific hybrid individuals as often as we have found them among the Cynipidae.

But do such inter-specific hybrids ever give rise to populations that deserve to be called species?

It must be remembered that transition zone populations grade in every direction into the pure populations between which they are hybrid. Any portion of such a hybrid population is different biometrically from any other portion of that population. The genes available at one point in the transition zone are not equally available at every other point in the zone. There is no common heredity within the population. It does not satisfy our concept of a species (p. 20), no matter how extensive the area over which it occurs.

But if such a population, of hybrid origin, should in some way become isolated, then it might in the course of time become a fairly uniform population. Relieved from the continual introduction of genes from the parental stocks, the hy-

brids might finally achieve a thoro exchange of genes thruout the whole of the population. Then a sample taken from any part of the range would vary within the same wide but uniform limits typical of every other sample of the population. It would then satisfy our concept of a species, for it would have a common heredity.

It is this problem, the attainment of homogeneity out of a hybrid population, that has become the immigration problem of the American people in the last half-century. Whether homogeneity is a biologic virtue or not, the statesmen have shown themselves good taxonomists in their insistence that we cannot become a true species until barriers are erected to protect us from continued contributions of parental stock. Whether in peoples or insects, the melting pot cannot blend diverse materials that pour in too rapidly.

Now it becomes obvious why hybrid populations cannot often give rise to new species. Such inter-specific hybrids must usually arise in limited areas between the parental species. As long as the area is limited and the parents are close at hand, the hybrids will continue to be hybrids of every shade and extreme and intermediate combination of parental characters. On theoretic grounds, it would appear that hybrids may become species only when geographically removed or in some other way isolated from the parental stock. These circumstances would seem so rare that we cannot believe that hybrids account for the origin of many of the species with which we are acquainted in the field today.

And yet, there is one group of species among the Cynipidae which would seem to have had hybrid origin. These species occupy that very portion of the northeastern United States in which so many of our biologic studies have been pursued. *Cynips erinacei,* to which repeated reference has already been made, is the most certain of these cases in the genus *Cynips.*

Erinacei, it will be recalled, is a highly variable species occupying about 500,000 square miles of the area which we have just defined. It is unique among *Cynips* in the extent of its individual variation. The extreme individuals of the group have previously been considered representatives of two distinct species, but the specific unity of *erinacei* is affirmed by the existence of every type of intergrade between these extreme individuals, and by the occurrence of all these varia-

tions in every large series which we have from nearly a hundred localities well spread over the range.

The interpretation of this population has become possible thru the discovery of its closest relatives, *Cynips wheeleri* to the north and *Cynips derivatus* to the south of the area occupied by *erinacei* (see map, fig. 63). *Erinacei* occurs exactly where we might expect a hybrid of *wheeleri x derivatus* origin.

Wheeleri is a uniformly small insect; *derivatus* is large; *erinacei* shows every gradation between the extremes. *Wheeleri* is largely black; *derivatus* is prominently rufous over most of the body; *erinacei* shows every sort of combination and recombination of these characters. The mesonotum of *wheeleri* is largely smooth and naked; the mesonotum of *derivatus* is rough and more hairy than in any of the related species; the mesonotum of *erinacei* varies from smooth and more naked to rough and hairy, again showing every gradation and combination between the supposed parents. The galls of *wheeleri* are ellipsoidal, polythalamous, and uniformly spiny; those of *derivatus* are spherical, one- or two-celled, and uniformly naked; the galls of *erinacei* (figs. 312-315) show these extremes and a remarkable series of every conceivable intermediate between and combination of these extremes. Detailed descriptions of the insects are given in the systematic portion of this study. Remembering that many of these characters are probably controlled by multiple factors in heredity, *erinacei* appears as just that variable combination of characters which we might expect from a *wheeleri x derivatus* cross.

This interpretation finds confirmation in such series as the 107 insects which we have from Meadville, in the northwestern corner of Pennsylvania. In this series 41 per cent of the individuals show clear evidence of *wheeleri* affinities, 37 per cent are practically identical with our Alabama and Georgia material of *derivatus*, and 21 per cent show gradaations between *wheeleri* and *derivatus* that would pass as good *erinacei*. It is certain that *erinacei* is not of present-day origin, for *wheeleri* and *derivatus* are separated thruout most of their ranges by several hundreds of miles. This distance is too great to allow any present-day hybridization of pure stocks of *wheeleri* and *derivatus*. The occurrence of the

three types of insects at Meadville is, however, the picture of segregation from a hybrid population which continues to proclaim its parentage. Similar series of *erinacei* are in our collections from many other localities.

There is, of course, a ready explanation of a past contact of *wheeleri* and *derivatus*. If *wheeleri* was in existence during the Pleistocene glaciation, its range must have been pushed southward at least as far as southern Indiana and the Ohio River, and still further south in the eastern mountains. If the range of *derivatus* at that time was comparable to the range of the present-day species, *wheeleri* first hybridized with *derivatus* in the Ohio Valley and in the valleys adjacent to the southern Appalachians. But as the glaciers retreated to the north, *wheeleri* retreated with them, leaving *derivatus* far to the south, and a tremendous area between where the hybrid *wheeleri x derivatus* found its opportunity to breed and interbreed until it had acquired the uniformity which warrants its present recognition as a species.

The Pleistocene origin of *erinacei* finds confirmation in three other hybrid species of *Cynips* in the same Northeastern area of the United States. These species are *Cynips fulvicollis, C. gemmula,* and *C. macrescens.* The detailed data are presented in the systematic portion of this study. They parallel the case of *erinacei.* These four cases account for all of the stocks of *Cynips* which are known to have penetrated far enough into the Northeast to have developed sub-Canadian varieties which would have been affected by the Pleistocene glaciation. These four cases are the only ones among the 93 species of *Cynips* which we now have reason for believing of hybrid origin, except for *C. advena,* of the Cumberland Highlands, which we shall show in a moment to date also from the Pleistocene. Of all the areas occupied by Cynipidae in the United States, this Northeastern area, the Eastern mountain country, and areas immediately adjacent to these are the only ones which had a Pleistocene history that would have provided the opportunity for the multiplication of hybrid individuals and which would have offered a subsequent isolation sufficient for the origin of new species. The apparent restriction of the hybrid *Cynips* to those areas seems confirmation of our explanation.

The fifth case *C. advena,* which we have mentioned, in-

volves a *wheeleri x pezomachoides* cross in the Cumberland Highlands and the Appalachian areas of central and eastern Tennessee, North Carolina, northern Georgia, and the borders of adjacent states in the South. Individuals that are certainly hybrids between *wheeleri* and *pezomachoides* are common from northern New England to Georgia wherever *wheeleri* still comes into contact with *pezomachoides*. Such hybrid individuals may be interpreted with much certainty and they confirm our explanation of *advena* in the Southern Highlands. The unusual amount of variation, the occurrence of segregates that appear as pure *wheeleri* or pure *pezomachoides*, and the geographic position of the hybrid between the supposed parents is, as with *erinacei*, the basis for recognizing the origin of *advena*. Segregates of *wheeleri* are more common in *advena* than in *erinacei*, probably because *advena* is not yet free from current contributions from the nearly pure populations of *wheeleri* which occur in the southern mountains. The galls of *advena* are interesting because they run largely to the smooth form typical of *pezomachoides*, indicating some dominance of *pezomachoides* characters; but *advena* galls are very finely bristly, and large series do include a few that are as strictly spiny as those of *wheeleri*.

We have then, out of the 93 species in the genus, the following which we would recognize as of hybrid origin:

C. fulvicollis (= *C. canadensis x major*)
C. gemmula (= *C. suspecta x fuscata?*)
C. erinacei (= *C. wheeleri x derivatus*)
C. advena (= *C. wheeleri x pezomachoides*)
C. macrescens (=*C. scelesta x opima*)

PHYLOGENETIC HISTORY

ANALYSES of the phylogenetic history of any group of organisms and biologic interpretations of taxonomic data depend for their validity upon the soundness of the available classifications of the group. If the catalogs are poorly made, one may draw no conclusions or, what is worse, draw conclusions as fantastic as the hobgoblins of primitive imagination. But if the taxonomic arrangement brings together species of common ancestry and accurately portrays the varying degrees of relationship between those species, a classification becomes one of the most powerful tools available for the evolutionary interpretation of biologic phenomena. It becomes a code by which one may translate the biologic and distributional data into the story of the origin and paths of dispersion and the order of development of each species and of each biologic characteristic of a group, from its primitive beginnings and thru the several stages by which it evolved the peculiar phenomena which we find today.

Phylogenetic interpretations of the genus *Cynips* have heretofore been impossible because cynipid genera, in common with the genera of many other insects, have been established for the most part upon "diagnostic" characters of insect morphology. These have been drawn from the toothed tarsal claw, the dorsally produced and naked abdomen, and the hairy thorax of the agamic form of the species *folii*, the genotype of the group (see Mayr 1870-1905, Dalla Torre and Kieffer 1910, Beutenmüller 1911, and Weld 1922-26, where the names *Dryophanta* or *Diplolepis* are used instead of *Cynips*). The insects included in the genus thus defined differed in many points of structure which, however, were consistently ignored. The genus included both black oak and white oak species, species that live in galls on flowers, leaves, stems, and roots, and galls of every conceivable type of structure (*e.g.*, see plates 12 to 17 in Beutenmüller 1911). There were species with divergent types of life histories. There were species that we shall ultimately have to assign to 8 or 10 distinct and largely unrelated genera. The extent to which our own interpretation differs from previous treatments becomes evident in the following table.

Author	Species assigned to present genus	Accepted in present revision
Mayr 1870-1905	17	88 per cent
Dalla Torre 1893	42	48 per cent
D. T. and K. 1902	50	46 per cent
D. T. and K. 1910	68	41 per cent
Beutenmüller 1911	43	32.5 per cent
Weld 1922-26	46	37 per cent

Our present delimitation of *Cynips* is based upon no single character—indeed, we know of no character by which the group may be separated from other groups of oak-inhabiting Cynipidae—but upon a striking, even if not invariable, correlation of insect structures, gall characters, host relationships, life histories, and distributional data that are coördinated for the 93 species which we now bring together.

In nearly every one of the species the agamic form has the thorax hairy, altho there are few hairs on the very small, nearly wingless insects which are the most northern varieties of many of the European and American species in *Cynips*. In every species without exception the hypopygial spine is broadest posteriorly, and the structure terminates in a well-developed tuft of hairs. A similar spine is found, however, in one or two related genera. In 90 of the species the tarsal claw is rather strongly toothed, but in 3 species of a single stock *(Cynips mellea)* the claw is so weakly toothed that it is nearly simple. In nearly all of the species the agamic gall is fundamentally spherical and monothalamous, rarely with any remarkable development of the epidermal layer of tissues; but in 8 species of one stock *(Cynips pezomachoides)* the gall is usually polythalamous. In every one of the 93 species the gall originates from leaf veins, usually on the under surface of the leaf, but in two species (*C. multipunctata* group) the gall may occur on the leaf petioles and young stems as well as on the leaf. In every one of the 11 species for which the alternating generations are known, the bisexual gall is a thin-walled, seed-like or bladdery, hollow cell located within the newly opened buds of the oaks. All of the 93 species occur on white oaks *(Leucobalanus)*. In nearly every case the agamic generation begins development in early summer, matures by early fall, lies as an adult within the gall for several weeks or months, and finally emerges in the winter. Only the 7 species of the *fulvicollis* stock modify this procedure by delaying part of the emergence until a second or later winter. Some of the species of the *mellea* stock also depart from the typical life history by emerging in the early spring instead of the winter season. In distribution the insects show their affinities by occurring in adjacent areas,

so the 93 species may be put into 28 groups and these in turn into 6 subgenera which constitute two main groups, each of which is a closely compacted unit in its geographic distribution.

Thus, while the genus cannot be based on any single diagnostic character, the remarkable coördination of so many characters in so many species and the absence of anything approaching this combination of characters among any of the other members of the family testify to the phylogenetic unity of *Cynips*. There seems no reason for believing that such a body of coördinated characters could have arisen independently in more than one time and place. In a single period, in a limited area, there must have existed a population from which all of the present-day species, with their varying grades of relationships, have developed. This history of the expansion of a single genetic stock into 93 distinct populations, by processes of mutation, isolation, and on occasion subsequent recombination into hybrid populations, is the story we have been unfolding in this study, and which we are now ready to fit into the geologic time and the geographic areas in which speciation probably proceeded in the genus.

Cynips is in every respect a highly specialized genus of the oak-inhabiting tribe Cynipini of the family Cynipidae. The fossil record of the Cynipidae is meager and without significance except to prove that the family was in existence in the Oligocene and Miocene (Kinsey 1919; Cockerell 1921). There seems no reason for believing that the Cynipidae have ever been associated with any plants except the Angiospermae on which the family occurs today. The diversity of the present-day genera of the primitive gall makers of the Aulacini indicates that that tribe must have had a long history antecedent to the origin of the Cynipini. The family could not have originated before the rise of the flowering plants in the late Cretaceous, and it was probably much later before the Cynipini developed such specialized genera as *Cynips* and *Disholcaspis*.

Our attempts to fathom the history of any of these higher genera must proceed on the assumption that all species of these groups have from the first been associated with oak, and our analysis of the cynipid history must do no violence to the known history of the sources and development of *Quercus*. To this end, the accompanying summary of the paleontological

record of American oak will serve as reference for some of the considerations that follow.

American Fossil Oaks

(Compiled from Trelease, 1924, and Berry 1923)

Area	Cretaceous	Eocene	Miocene	Pliocene	Pleistocene	Living oak flora
Northeastern Siberia	...	x	...	...	...	
Northwestern North America—						
British Columbia	x	x	...	...	...	Southern
Alaska	x	x	...	...	...	
Pacific Coast States—						
California	...	...	x	x	x	x
Oregon	...	x	x	...	...	x
Washington	...	x	x	...	...	x
Desert States—						
Idaho	...	x	x	...	...	
Nevada	...	...	x	...	...	Southern
Mountain States—						
New Mexico	x	x	...	...	...	x
Colorado	x	x	x	...	...	x
Wyoming	x	x	x	...	...	Northeastern
Montana	x	x	x	...	...	
Great Plains Area—						
Kansas	x	...	...	...	...	Eastern
Nebraska	x	...	...	...	...	Eastern
North Dakota	...	x	...	...	...	Southeastern
Middle West—						
Illinois	...	...	...	...	x	x
Southern States—						
Kentucky	...	...	...	...	x	x
Alabama	...	...	...	x	x	x
Tennessee	...	...	...	...	x	x
Mississippi	...	...	...	...	x	x
Virginia	...	...	x	x	x	x
North Carolina	x	...	...	...	x	x
South Carolina	x	...	...	...	...	x
Florida	...	...	...	...	x	x

Area	Cretaceous	Eocene	Miocene	Pliocene	Pleistocene	Living oak flora
North Atlantic States—						
District of Columbia	...	...	x	...	...	x
Maryland	x	...	x	x	x	x
West Virginia	...	...	...	...	x	x
Pennsylvania	...	...	...	...	x	x
New Jersey	x	...	...	x	x	x
New York	x	...	...	...	...	x
New England—						
Vermont	x	...	...	...	...	x
Greenland	x	x	...	...	...	
Iceland	...	x	...	...	...	
Spitzbergen	...	x	...	...	...	
South America	...	...	...	x	...	Mts. of Colombia

The ancient history of *Cynips* is first of all to be read in the characters and distribution of the six existent subgenera. The range of each subgenus is shown on the accompanying map (fig. 7), and the data are further summarized:

Subgeneric Ranges of Cynips

Subgenus	Species	Range
Cynips	11	Europe, Mediterranean Africa and Asia, possibly elsewhere in Asia.
Antron	12	U. S. Pacific Coast, California-Oregon, undescribed species in southern Arizona.
Besbicus	8	U. S. Pacific Coast, California-British Columbia.
Philonix	8	U. S., Arizona-Atlantic Coast.
Atrusca	12	Mexico; U. S., Arizona-Atlantic Coast.
Acraspis	42	Mexico; U. S., Arizona-Atlantic Coast.

These subgenera clearly represent two groups, which may be distinguished as follows:

1. Agamic female with hypopygial spine distinctly broad, very broad in *Besbicus;* wings normally 1.50 to 1.60 times the body length; all galls with nutritive, protective, more or less solid parenchyma and simple

epidermal layers, and in all but a few species with an unspecialized collenchyma layer; distribution Eurasian and Pacific American.

Cynips-Antron-Besbicus

2. Agamic female with normal hypopygial spine not very broad but well drawn out at the ventral tip; wings always under 1.35 times the body length; galls more diverse, with the collenchyma layer poorly developed in *Philonix*, the five layers present but the fibrous parenchyma much over-developed in *Atrusca*, and the collenchyma and epidermal layers constituting most of the gall in *Acraspis;* distribution entirely east of the Sierra Nevada in North America.

Philonix-Atrusca-Acraspis

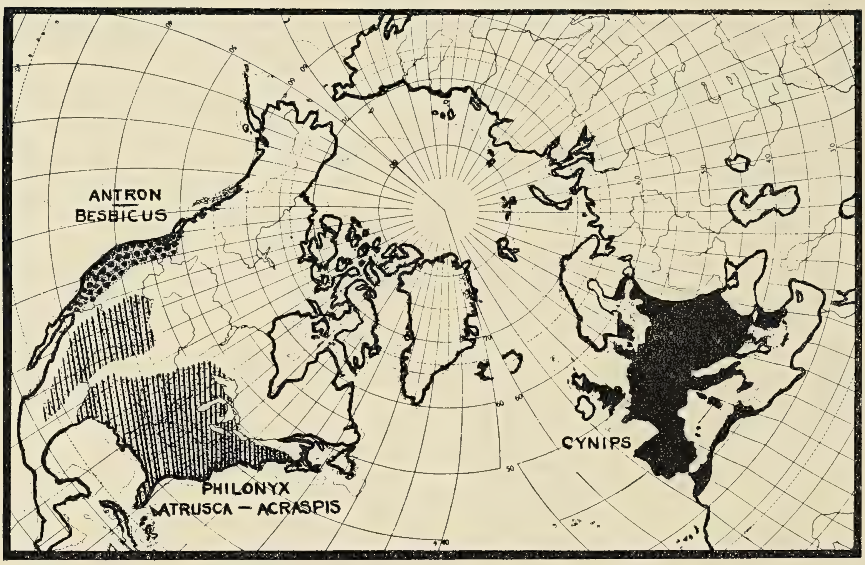


FIG. 7. KNOWN DISTRIBUTION, SUBGENERA OF CYNIPS
Base from Goode series of Base Maps, by permission University of Chicago Press.

The primary subdivision of the genus into one group that is all but exclusively Eurasian and Pacific American, and into a second group that is confined to North America east of the Sierra Nevada, should have occurred near the center of the origin of the genus. We may hypothesize this center in the southwestern United States or in adjacent areas of northern Mexico. From here the first subgeneric group could have moved westward to the Pacific Coast where *Antron* and *Besbicus* were isolated, and by way of Alaska and Siberia into Asia and Europe where the subgenus *Cynips* developed. The second group, differentiated into the subgenera *Philonix,*

Atrusca, and *Acraspis,* could have spread to the north in the Rocky Mountain area, to the south in Mexico, and to the east toward the Atlantic Coast. On the other hand, if the genus were assumed to have arisen in Europe or Asia, it is difficult to understand why the Eurasian affinities should have been maintained onto the Pacific Coast of North America, and a primary subdivision of the genus not effected until the group reached the Southern Rockies. However, we are completely ignorant of the present-day occurrence of the genus in most of Asia (on pp. 447 to 453 we show that the species reported from Japan do not belong to the genus), and further discoveries may throw light on Asiatic beginnings of the group; but from the available data we would presume the southwestern American origin for the genus and its initial differentiation in that area.

That the point of origin was not north of central Arizona or New Mexico is indicated by the occurrence of numerous short-winged species both north and east of the region, while not a single short-winged species of the group is to be found in the southern halves of those states. We have already shown that the short-winged species represent more specialized developments of the long-winged stocks. One short-winged and one long-winged species of *Cynips* is known from central Mexico, but our knowledge of the gall makers of that country is still insufficient to make it certain that our genus did not originate somewhere in northern Mexico.

It is interesting to find that Trelease (1924:34), considering the origin of the American oaks, states that "their primary center of distribution appears to have been what is now Arizona." Trelease's conclusion is based in part upon the opinion that the widely distributed Cretaceous oaks have left no descendants in present-day groups, and that the existent white oaks of Europe and Asia, and both the white and black oaks of America have developed from the type represented by the European, Tertiary *Quercus Palaeo-Ilex.* This type is presumed to have reached America at some time previous to the Cenozoic. Berry's criticism (1923:139) of this conclusion seems to be based upon a mis-interpretation of Trelease's involved presentation of the argument, but the matter needs more data than seem to have been derived from the Cretaceous fossils that are often dubiously referred to *Quercus.*

The close affinities of the Eurasian and Pacific American subgenera of *Cynips,* and the more unique nature of the eastern American subgenera suggests that the migration between Eurasia and North America was by way of the Alaskan-Siberian land bridge, rather than by way of former land connections between Labrador, Greenland, Iceland, and northern Europe.[1] The migration of the first group of *Cynips*

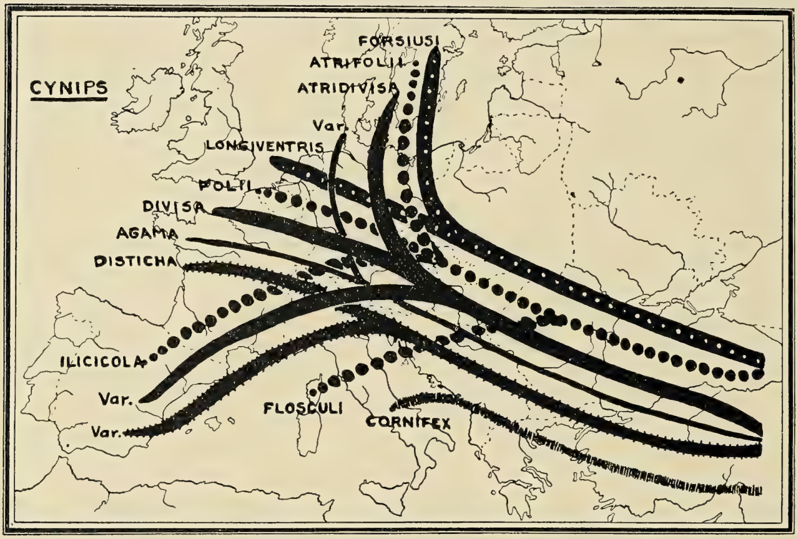


FIG. 8. PHYLOGENETIC ORIGINS, SUBGENUS CYNIPS

from its center of origin in the Southwest, to our Pacific Coast, and finally across Alaska into Siberia, must have occurred before the Great Basin became arid, and while the Alaskan-Siberian land connections were still enjoying a climate mild enough to have supported an oak forest. From the preceding table it will be seen that fossil oaks are known to have occurred in both Siberia and Alaska as late as the Eocene, and the land connections between the two continents were continuous thru the late Miocene and intermittently existent at later periods. Berry, however, expresses it as his

[1] Thruout this part of this study I have had the criticism of Dr. C. A. Malott and Dr. J. W. Beede of the Geology Department of Indiana University. Geologic data pertaining to this section are summarized in such texts as Miller's *Introduction to Historical Geology* (1916) and Schuchert's *Historical Geology* (1924). Berry (1923) and Trelease (1924) summarize the paleontological record of *Quercus*.

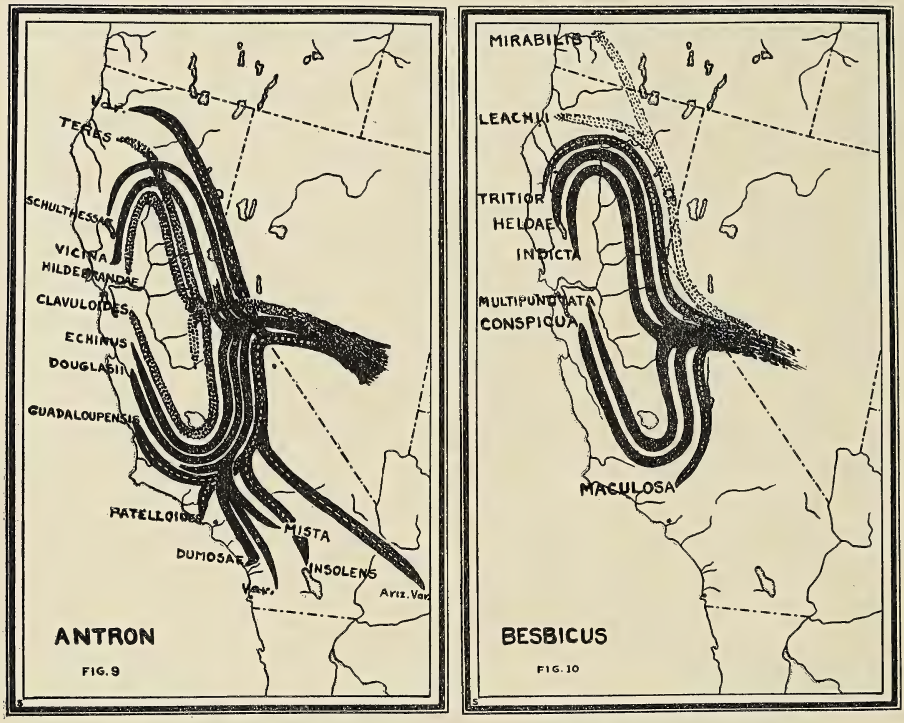
opinion (1923:140) that "it is very doubtful if there was any possibility of an interchange of species of oak between the Old and New Worlds after late Eocene or Oligocene times," and this may be the latest origin we may presume for the genus *Cynips*.

On the other hand, it is difficult to understand why both the primary subdivisions of the genus did not spread both to the east and to the west of their Southwestern center of origin if they migrated very much before the Great Basin became so arid as to interpose an effective barrier to further interchange of eastern and western species. It is understandable that each group might have begun its migration in a particular direction, but our knowledge of the present-day distribution of organisms would lead us to expect that a group should, in sufficient time, radiate in every direction in which there are no recognizable barriers to migration. But the rising mountains of the Pacific Coast probably did not bring about the development of the Great Basin deserts until the Miocene. If the Eurasian-Pacific-American branch of the genus crossed on to the Coast in the Miocene, its failure to radiate in other directions might be explained as due to the subsequent development of aridity in the Great Basin before the group had time to move back across that area. But if the group must be taken out of the Southwest and across Alaska at an earlier date, as Berry's statement would require, it is more difficult to understand why the Pacific Coast subgenera did not have an opportunity, before the Great Basin became arid, to spread back into the more eastern United States.

In the southernmost mountains of Arizona there is a living variety of the Pacific Coast species *Cynips (Antron) guadaloupensis*. This is the only representative of that subgenus known from east of the Sierras, but it is matched by a few cases in other cynipid genera and by a few Pacific slope trees, reptiles, and other organisms that have stray relatives in southern Arizona. These strays are, however, such close relatives of existent Californian species that they are probably to be interpreted as more recent arrivals in Arizona rather than remnants of the primitive stock before it moved westward into California. During the Quaternary the Great Basin had a more moist climate than it had had since the Miocene, and the area just north of the Gulf of California

then may have supported enough oak to have allowed the extension of some species of the typically Californian fauna.

Within California the paths of migration of the several species of *Antron* and *Besbicus* probably began at some point in the eastern part of the state and extended north and south and about the Great Valley. The Valley was not completely cut off from the sea until the Pliocene and Pleistocene. The



FIGS. 9-10. PHYLOGENETIC ORIGINS IN ANTRON AND BESBICUS

present-day range of many plants and animals of the foothills of the mountains rimming the Great Valley may be due not only to differences in topography and climate and vegetation at different elevations, but to the influence of the more ancient distribution as well. Altho many Cynipidae range all the way from Bakersfield in the southern end, to Shasta Springs at the extreme northern end of the Valley, and altho many of the species of the foothills and even higher elevations of the Sierras find no barrier in the latitude of San Francisco, many

of the insects of the Coast Ranges have northern varieties that reach their southern limits and southern varieties that reach their northern limits near San Francisco Bay. If the migration in such cases had been wholly from the north or wholly from the south, it is not easy to understand why the break should occur near San Francisco Bay; but the situation is explainable if it is presumed that both stocks originated from the eastern Sierras, that the northern variety reached San Francisco Bay from the north and the southern variety from the south, and that the Bay never was crossed until a geologically recent day.

The Eastern American group of subgenera of *Cynips* was differentiated in the late Miocene or early Pliocene, as the following considerations may show.

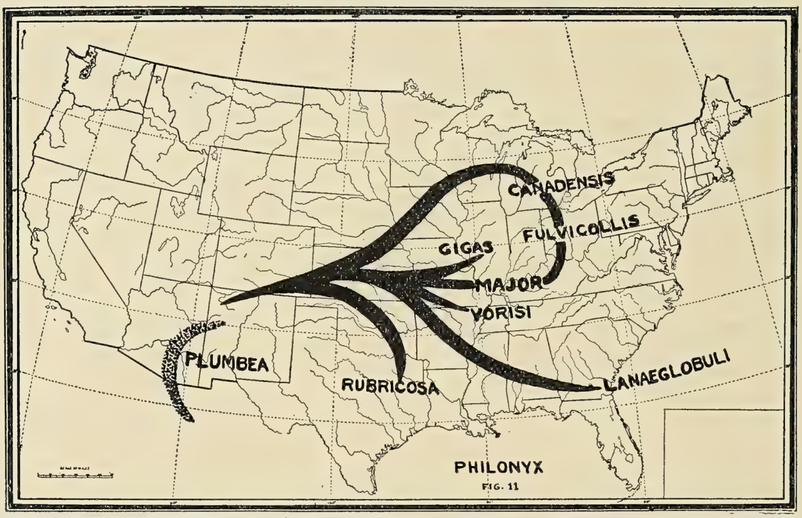
None of these subgenera are represented west of the Great Basin today, and it is probable that they were prevented from reaching the Sierras by the development of the Great Basin deserts in the Miocene.

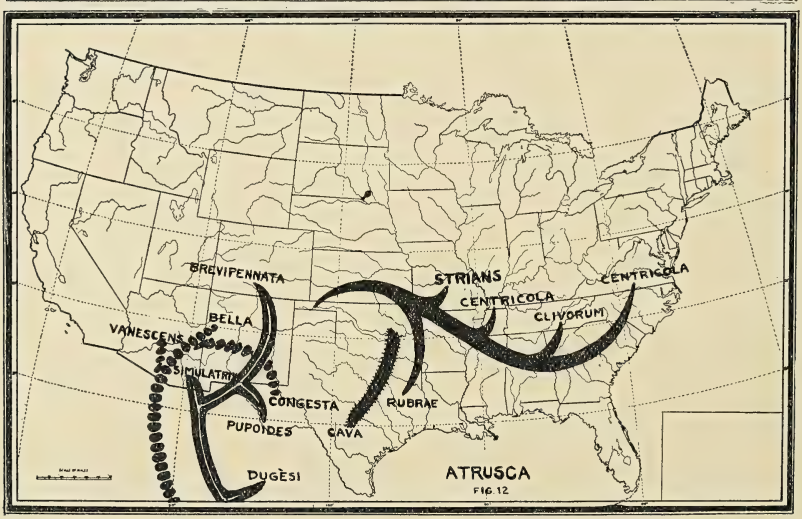
That the subgenera were distinct and most if not all of the present-day species differentiated before the end of the Pliocene is attested by the fact that all but one of the species found east of the Great Plains is represented by close relatives, either very closely related species or varieties of the same species, in the Rocky Mountain area. The following table summarizes the situation.

Eastern Species	Rocky Mountain Relatives
C. fulvicollis	*C. plumbea*
C. centricola	*C. dugèsi and C. bella*
C. pezomachoides	*C. pezomachoides*, 1 variety
C. gemmula	Not known
C. hirta	*C. hirta*, 2 varieties
C. villosa	*C. villosa*, 5 varieties
C. mellea	*C. mellea*, 1 variety; and *C. arida*

This eastern extension of the Rocky Mountain fauna must have occurred before the Rockies reached their heights and thus caused the aridity of the Great Plains in the Pliocene. Today, between the easternmost oaks in Colorado and the westernmost extension of oaks in Kansas there are three or

four hundred miles of Plains that are now barren of oak. Between the Rocky Mountain oak of northern Colorado and the westernmost extension of the eastern *Quercus macrocarpa* in northwestern Nebraska is a stretch of fully two hundred miles. In the Black Hills of the South Dakota-Wyoming boundary, this same eastern oak comes into contact with the Rocky Mountain *Quercus Gambelii,* but this could at most





FIGS. 11-12. PHYLOGENETIC ORIGINS IN PHILONIX AND ATRUSCA

supply a present-day means of eastern migration for only those species of *Cynips* that occur on the *Gambelii-macrocarpa* oaks. There are two such species, *Cynips villosa* and *C. hirta*. *Villosa* may, for all that is now apparent, have crossed from the more northern Rockies. On the other hand, the more southern concentration of the varieties of *C. hirta,* in part upon the chestnut oaks, suggests that this species came eastward by the Colorado-Missouri route which, we shall show in a moment, was followed by the remaining species of the genus. Any cak-inhabiting cynipid that crossed in this part of the Plains must have done so before the extermination of the oak flora in those areas in the Pliocene.

It is possible that during the southernmost extensions of the glaciers of the Pleistocene some increase in moisture allowed oak to return to some southern parts of the Great Plains. It is certain, however, that the several stocks of *Cynips* had come east before then, because in the northern Middle West there are several species which, as we have shown (page 59), seem to have had a hybrid origin in the Pleistocene. If the southern extension of the glaciers at that time crowded northern varieties into the ranges of southern varieties of the same species, with consequent hybridization of the close relatives, it follows that northern and southern varieties were already differentiated in the eastern United States.

Altho eastern and western species of oak make rare contacts in the Texas Panhandle and in northeastern New Mexico, the affinities of all the Cynipidae of Texas east of the Pecos River are clearly with those of the eastern United States, while all the Cynipidae of West Texas are of more direct origin from the Arizona-New Mexico stocks. The geologic record indicates that the desert boundary between West Texas and the more eastern part of the state is more ancient than the genus *Quercus*. One may conclude that the cynipid fauna of eastern and central Texas has been derived from the north and east and not directly from the Southwest.

The present-day concentration of the species of *Acraspis* (fig. 49) indicates that the eastern migration did not occur very far north of Texas. It probably occurred in Kansas and Missouri, or not far north or south of the boundaries of those states.

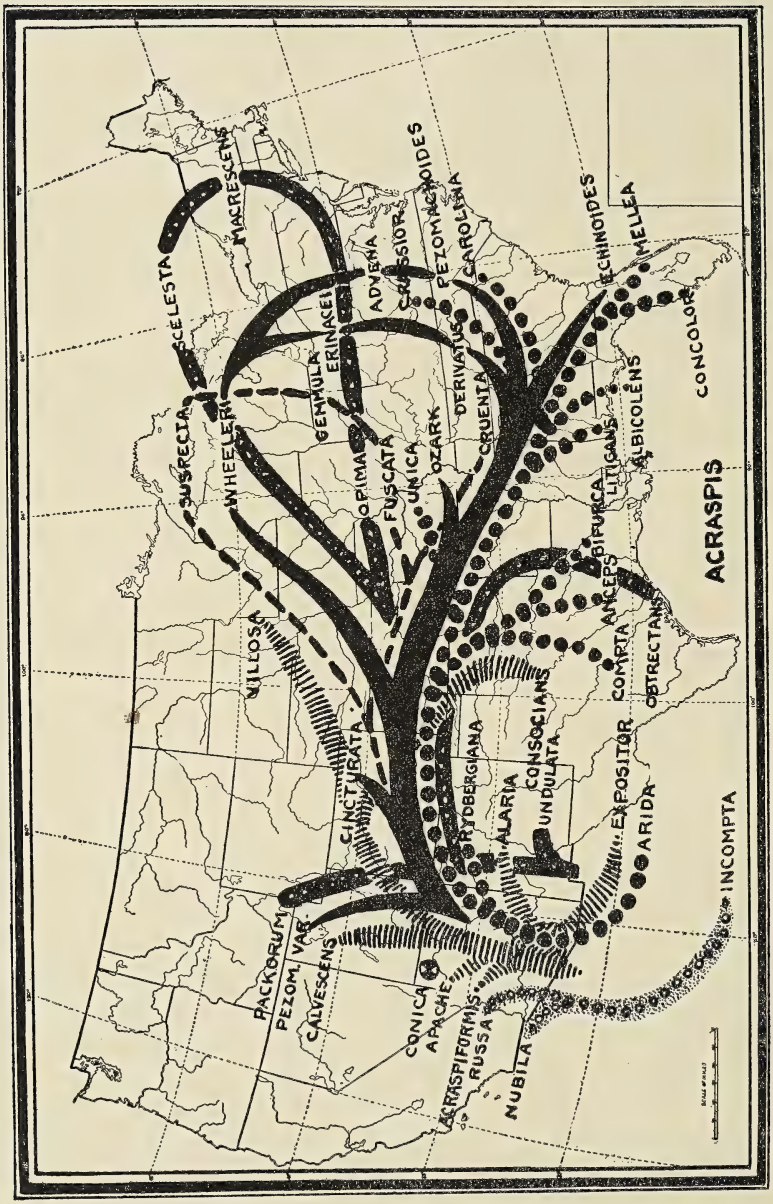


FIG. 13. PHYLOGENETIC ORIGINS IN ACRASPIS

The chief path of migration of *Cynips* moving eastward from Missouri probably bent southward about the southern Appalachians and finally up the Atlantic Coastal Plain. The present occurrence of so-called Coastal Plain Cynipidae, or close relatives of Coastal Plain species, across the state of Missouri, thru adjacent parts of the Mississippi Valley, and along the course of the Tennessee River, as well as out on the Atlantic Coastal Plain itself, probably records the path of migration from the Rockies to the easternmost limits of the United States. In the systematic portion of this study data bearing on this point are recorded and mapped under:

Cynips centricola centricola
C. pezomachoides pezomachoides
C. pezomachoides derivatus
C. gemmula fuscata
C. mellea carolina

The restriction of the short-winged species of each of the stocks of the eastern subgenera to those points which are furthest along this supposed route out of the Southwest, is some further verification of the route. Spreading to the north and to the south of this main path, the ancestral stocks gave rise, by mutation and isolation and, in the few cases noted, by subsequent recombination of characters in hybridization, to the numerous populations which are the species or varieties today. This history is summarized in the phylogenetic maps.

Many will find the present-day species of our genus not easy of identification. There are some who are inclined to believe that species are, after all, but human concepts instead of realities in nature. Some will consider that individuals are so variable and interbreeding Mendelian races so abundant in nature that taxonomic classifications can be nothing but contrivances without biologic significance. And yet, when the Colorado of the West first cut into the Colorado Plateau the specific stocks of *Cynips* were in existence, and thruout the years that the Canyon has been cutting, even down onto the present, these complexes which we call species have maintained their identity. While the eternal hills have come and gone, these instable protoplasmic entities have maintained their stability. A stability like that of a stream, with materials always contributing from many sources, with endlessly

Phylogenetic History

Epoch	Time estimate, millions of years	Geologic events	History of Cynips
Upper Cretaceous	80–60	Rise of flowering plants Origin of oak First rise of Rockies and Sierras	Ancestral Cynipidae
Eocene	60–35	Alaskan-Siberian connection maintained, climate mild, oak in the area	Differentiation of main groups in the family
Oligocene	35–20	Alaskan-Siberian connection maintained, climate mild, oak in the area Great Plains forming	*Cynips* and other modern genera in existence Eastern and western subgenera separated
Miocene	20–7	Alaskan-Siberian connection continuous, climate more severe Rockies elevating, deserts forming in the area Finally Alaskan land connections broken	Subgenus *Cynips* moves into Eurasia *Antron* and *Besbicus* species differentiate on Pacific Coast *Acraspis*, *Atrusca* and *Philonix* specific stocks arise in southern Rockies
Pliocene	7–1	Great Valley of Calif. in part an inland sea Rockies elevated and Great Plains become semi-arid Sierras elevated and Great Basin becomes more arid	Specific stocks of eastern subgenera move across Great Plains Modern species and varieties differentiated in all groups
Pleistocene	1 million to 20,000 years	Grand Canyon begun Extensive glaciation Cold climate south to Ohio River Moist climate in parts of Great Basin and north of Gulf of California	Northern varieties pushed south to hybridize with southern varieties Some Calif. species migrate back to so. Arizona

changing waters, varying currents and eddies—the stability of a stream that spreads over the lowland or thru the delta with a dozen offspring streamlets, while the flowing stream still remains the stream of yesterday, today, and tomorrow.

Tho the taxonomist's specimens seem insignificant, the data tedious, and the dry-rot of the technic unendurable, the pinned specimens in the box are a bit of the forests and the hills and the days where the drama of wasp life is unfolded, an evidence of ancient origins, mutating genes, and inexorable marches of evolution, an epitome of the enduring and everlastingly changing entities which are species.

PART II. SYSTEMATIC DATA

OUR conclusions on the nature and origin of the species of *Cynips* given in Part I of this study have been based upon the data now presented as the routine taxonomic treatment of the varieties, species, and subgenera of the gall wasp genus *Cynips*.

Cynips, as here defined, is a group of 93 highly specialized, oak inhabiting gall wasps, 26 of which have previously been included in this genus. Of the remaining species, 19 have been previously assigned to other genera, and 48 are here described as new.

Since we are dealing with the oldest name in the family Cynipidae, it is of moment to review the varied history of the nomenclature and of the taxonomic concept. This history begins with the Linnean adoption of the term (1758:553) to cover essentially all of the insects which he knew from plant galls. His *Cynips,* with 14 specific names, included species that we now place in six distinct genera distributed among the three tribes of the Cynipidae, as well as several species of chalcidoids, some of them parasites bred from galls produced by tenthredinids (Hymenoptera) and by cecidomyids (Diptera). Geoffroy, a contemporary of Linnaeus, made a better distinction (1762) between gall makers and parasites, altho calling the parasites *Cynips* and the gall makers *Diplolepis.* During the next century several attempts were made to fix the type of *Cynips,* but the only designation acceptable under the present International Rules was made by Westwood, in 1840, who named *folii,* probably the best known of all European gall wasps, as the type of the genus. Detailed discussion of this designation is given in the introduction to the European subgenus in this study. European usage largely followed Westwood's designation until Mayr, in 1871, used Förster's *Dryophanta* in precisely the sense defined by Westwood for *Cynips,* and Mayr's usage was adopted for the next half century. In 1910, however, Dalla Torre and Kieffer returned to Geoffroy's *Diplolepis,* and several recent authors have followed this practice, altho the usage is not approved by the findings of any of those (Morice and Durant, Rohwer and Fagan, Bradley, etc.) who have critically reviewed the question.

More unfortunate than this use of several terms for our present genus has been the European application of the term *Cynips,* ever since Mayr's publications, to a totally different genus which Rohwer and Fagan have re-named *Adleria.* It is to be regretted that our International Rules do not allow us to recognize this usage, but as long as we operate under the rules, we should apply *Cynips* to the phylogenetic unit which includes the species *folii,* and which, therefore, is strictly synonymous with Förster's *Dryophanta.*

The taxonomic concept of our present genus has only slowly emerged from this nomenclatorial confusion, altho in the brilliant revision of the Cynipidae by Hartig in 1840 all of the then-known (5) European species that we now recognize in this genus were brought together as numbers 2 to 6 of the *Cynips* there defined. The unity of the present group was further emphasized in 1881 by Mayr and we have already shown that 88 per cent of Mayr's inclusions are still acceptable. No later author has, in our judgment, had more than 48 per cent of his inclusions warranted phylogenetically (see page 62).

This widespread confusion in the interpretation of *Cynips* has not been wholly consequent on the difficulty of interpreting the relatively uniform structures of gall wasp species. Felt (Journ. Econ. Ent. 19:672) considers the situation due to the complex life cycle of our insects and to the failure of a sufficient number of economic entomologists to turn to cynipid taxonomy as an avocation. It is our own judgment that the poor work is the result of using book descriptions and "diagnostic characters" convenient for the manufacture of "Keys," instead of actual specimens and adequate series of the species involved. The current chaos in the interpretation of cynipid genera dates from the publication, in 1893, of the cynipid volume of the Catalogus Hymenopterorum by C. C. de Dalla Torre, a painstaking bibliographer, but a systematist with a naïve faith in published descriptions and a supreme interest in the convenience of a classification. Later treatments of *Cynips* have uncritically accepted the Dalla Torre Catalog. If I depart from this tradition, it is because I believe that the study of thousands of individuals, representing all of the species of a group, are a sounder basis for phylogenetic interpretations than a catalog made by a biblog-

rapher who appears never to have seen two-thirds of the species involved.

The characters on which we base our present interpretation have been discussed in the first part of this study. We may repeat that we know no single character, morphologic, physiologic, or biologic, by which a *Cynips* may invariably be recognized. A hairy thorax, complete parapsidal grooves, undivided foveal groove, hypopygial spine which is broadened nearer the tip; a monothalamous, fundamentally spherical, separable leaf gall, occurring on a white oak; and the maturing of the adult early in the fall with emergence delayed until the winter—this is a combination of characters that will distinguish most of the agamic forms. The use of the dorsally produced and largely naked abdomen and the toothed tarsal claw of the genotype, *folii,* as diagnostic characters would lead to the inclusion of many species that do not belong and the exclusion of more species that do belong to true *Cynips*. The existence of both long-winged and short-winged species in the same genus is discussed in pages 25 to 36 of this study.

In the following treatment, each variety is handled under the following heads:

Synonymical Bibliography.
Comparative Descriptions: female, male, gall.
Range.
Types: data upon and location of type specimens.
Original Descriptions: quoted only if types have not been available for this study.
Inquilines.
Parasites.
Biologic and Phylogenetic Discussion.

All data presented in this study are original unless accredited ("acc.") to other sources in the literature or to friends who have provided insects and galls for my use. All locality records apply to both insect and gall material examined unless specifically given for galls only or upon the basis of published authority.

The nomenclature follows the International Rules with one exception: Names originally published with a *quercus* or *Q.* between the generic and specific term are considered polynomials and without nomenclatorial standing under Opinion 50 of the Code, but accepted in this study as binomials—

dropping the inserted host term—dating from the original publication. From Linnaeus to present students of the group, nearly everyone except the International Commission on Nomenclature has considered such names binomial and my present usage is in accord with practically all current practice among cynipid workers. Under date of October 16, 1923, the attention of the International Commission was directed to the impracticability of changing more than a hundred names affected by Opinion 50 in the relatively small family Cynipidae alone; but to date (six years later) we have only the formal acknowledgement of the communication by the Secretary of the Commission.

The species now accepted as true *Cynips* have been discovered as follows:

In 1770,	1 variety,	1 species was known	
By 1790,	0 varieties,	0 species	were added
By 1810,	0 varieties,	0 species	were added
By 1830,	0 varieties,	0 species	were added
By 1850,	5 varieties,	5 species	were added
By 1870,	6 varieties,	5 species	were added
By 1890,	11 varieties,	6 species	were added
By 1910,	6 varieties,	0 species	were added
By 1930,	64 varieties,	9 species	were added
Totaling	93 varieties,	26 species	

Nearly two-thirds of the varieties have been described since the beginning of the World War. There are almost as many varieties now known in this genus as Riley (in Bassett 1882:330) predicted in the American fauna of the entire family Cynipidae.

The great increase in known forms within the last twenty years would suggest that now we must have exhausted the ready opportunity to print "new species" after a *Cynips;* but to one acquainted with the number of unexplored faunas in the highly varied biologic areas of the United States, with our almost complete lack of knowledge of the Cynipidae of the two largest oak floras in the world—in Mexico and southeastern Asia, or even with the scant work done on the gall wasps of more northern and Mediterranean Europe, it may appear that we are only laying a foundation for extensive discoveries yet to be made in this very genus of insects. It is astounding that any one had a fair concept of species a

generation ago, when the mere fact of the existent species was hardly conceived. It becomes evident that the complexity of many a group may still be far beyond anything of which we are yet cognizant. Surely, taxonomic research is but on the threshold of data from which we may ultimately proceed to sound conclusions on matters of prime concern in the science of biology.

CYNIPS Linnaeus

Details of synonomy and type fixation are given under the several subgenera. As here defined the genus includes:

Cynips Linnaeus, 1758 (in part), Syst. Nat. Ed. 10, 1:553.
Philonix Fitch, 1859, 5th Rpt., Nox. Ins. N.Y.: 783.
Dryophanta Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 335.
Acraspis Mayr, 1881, Gen. gallenbew. Cynip.: 2, 29.
Sphaeroteras Ashmead, 1897, Psyche 8:67.
Antron Kinsey, new subgenus.
Besbicus Kinsey, new subgenus.
Atrusca Kinsey, new subgenus.

AGAMIC AND BISEXUAL FEMALE.—In the agamic form generally rufous, rufous brown, and piceous in color, less often light brownish rufous or black, the abdomen usually darker than the thorax; the body of the bisexual female almost entirely black.

Head distinctly narrower than the thorax if the thorax is distinctly robust, nearly as wide as the thorax if the thorax is more slender as it is with most forms, distinctly wider than the thorax if the wings are short and the thorax consequently reduced; the cheeks more or less protruding beyond the eyes (in the agamic female) or the eyes larger and extending as far as or slightly beyond the cheeks (in the bisexual female); malar space between one-third and one-half the length of the compound eyes, quite without a malar furrow or at most with a faint indication of a furrow; with a low, broad, more or less indefinite median ridge; head irregularly coriaceous to finely rugose, scatteringly hairy, the hairs light yellowish, longest on the face and about the edges of the head, the vertex more naked. Antennae rufous to dark brown or black, often brighter basally, finely hairy (less so in the bisexual female), of moderate length or long, always slender, hardly enlarged terminally; with 13 to 15 segments, the first of moderate length, swollen, vase-shaped, the second no longer than wide, the third a third or more longer than the fourth, the penultimate segment a little longer than wide, the last one-quarter to one-half again as long as the preceding, the last two segments sometimes incompletely separated.

Thorax moderately large to very large and heavy (in long-winged varieties), or much reduced in size (in short-winged varieties), usually a little longer than high (as high as long in short-winged varieties), three-quarters again as long as wide in short-winged varieties, nearly

twice as long as wide in the bisexual form. Mesonotum of the agamic forms more or less closely but shallowly punctate, with scattering, moderately long, yellow hairs, in part smooth, in part coriaceous to finely rugose between the punctation; the mesonotum of the bisexual females finely or sparingly roughened and sparsely hairy if not entirely smooth and naked; parapsidal grooves continuous or (in a few long-winged forms and several short-winged forms) more or less obliterated anteriorly, not wide, of moderate depth, smooth at bottom (except anteriorly in a few cases), gradually convergent but still not close together posteriorly, gradually divergent anteriorly (or sharply divergent if the thorax is very large and robust); median groove usually lacking (but some varieties have an indication of some median groove, especially posteriorly); anterior parallel lines (in most long-winged agamic forms) narrow to broad, moderately separated, wholly or in part finely punctate, or (especially in short-winged varieties and bisexual forms) not well defined, more obscure or obliterated anteriorly, slightly broadened and more or less divergent posteriorly; lateral lines (in long-winged agamic forms) mostly smooth, naked, rather broad, approaching the scutellum posteriorly but not extending to the parapsidal grooves anteriorly, these lines more or less obliterated in some long-winged varieties and in most short-winged varieties and bisexual forms. Scutellum of normal size, of moderate width, distinctly longer than wide (in long-winged varieties) or small and not much longer than wide (in the forms with the shortest wings), hardly broadened posteriorly, well rounded at the tip (more pointed in some short-winged varieties); flattened to cushion-shaped, often (not always) with a slight flattening, depression, or elevation along the median, longitudinal line; punctate and finely or more heavily rugose; scatteringly hairy, the hairs densest along the edges; with a shallow, arcuate foveal groove (which often grades into the anterior depression of the scutellar disk, especially in short-winged varieties), this groove undivided or at least with not more than a very fine, indefinite division into foveae; a well-defined foveal ridge separating the scutellum from the rest of the mesonotum (the ridge indefinite in some short-winged and bisexual forms); pronotum very narrow anteriorly (in long-winged forms), or broadened and distinctly visible dorsally (in many short-winged forms); laterally rugose and punctate, with not long, not dense, yellowish hairs. Mesopleura (of agamic forms) at least in part and sometimes wholly punctate and scatteringly hairy, smooth and shining between the punctations; the mesopleura of bisexual forms more nearly smooth and naked.

Abdomen of moderate size (in long-winged forms) or larger (in short-winged forms), one-third to three-quarters again as long as high; in some varieties not produced dorsally or ventrally, with the second segment not tongue-shaped; in other varieties (and in all bisexual forms) more or less produced dorsally with the second segment tongue-shaped; the second segment covering one-half to two-thirds of the whole abdomen (less than a half in some short-winged forms); the abdomen usually smooth, shining, and naked except for sparse patches of hairs latero-basally (with even these hairs reduced in bisexual forms), or

sometimes the entire abdomen has a not dense coating of hairs, or (in the agamic forms of the subgenus *Besbicus* and in still other agamic forms) the sides of all the abdominal segments are well coated with appressed hairs. Hypopygial spine of agamic forms large but not extending much further than the lateral lobes of the hypopygium; the spine distinctly broad, in some instances very broad, a broadened area usually nearer the tip than the base of the spine (in most wingless forms of the subgenus *Acraspis* the spine is of uniform width for its whole length); sometimes the dorsal point, sometimes the ventral point of the spine extends furthest; much of the spine punctate and hairy, the tip bearing a tuft of long, yellowish hairs; the whole spine a little smaller in short-winged forms and still smaller, narrower, and less hairy in bisexual forms. Ventral valves not prominent.

Legs long, wholly punctate and hairy; tarsal claws usually of moderate weight, heavy in the subgenera *Besbicus* and *Philonix;* usually strongly toothed, less strongly toothed in bisexual forms, in a few agamic females only weakly toothed.

Wings usually long, extending fully one-half of their length beyond the tip of the abdomen; or wings reduced to three-quarters or to half the normal length; or wings reduced still further, being in many cases mere stubs; the shortened wings with reduced venation. If long, the wings are clear or slightly tinged with yellow, set with short, dark hairs which form a short fringe about the entire margin, the fringe longest on the hind margin; veins moderately heavy to very heavy, the subcosta, radius, and basalis always the heaviest, dark brown, and more or less limitedly infuscated; the subcosta not reaching the margin, colorless at a point near the origin of the radius; the first abscissa of the radius arcuate-angulate to distinctly angulate at a little more than 90°, more or less infuscated, without a point or with a short point projecting from the apex of the angle into the radial cell; the second abscissa nearly straight or slightly curved or, usually, more curved especially toward the tip, the vein ending distinctly back of the margin of the wing, the tip in many species triangularly expanded; the radial cell moderately broad, sometimes short, sometimes long, always open; areolet always present; cubitus fine, continuous, reaching the basalis near the mid-point, slightly infuscated at the basalis; all of the cells clear, or the cubital and (less often) the discoidal and (rarely) the radial cells with irregular, dark spots or larger, more indefinite, more smoky patches.

Length 1.2 to 5.0 mm., the agamic forms averaging nearer 3.0 mm., the bisexual forms nearer 2.0 mm., the agamic insects in general moderately large and robust, the bisexual forms usually more slender but not always shorter than the corresponding agamic generations.

MALE.—Differs from the bisexual female of the same species in having the compound eyes a little larger, protruding further beyond the cheeks; the antennae almost uniformly dark or at least darker on the basal segments, with one more segment than in the female, the third segment a little longer than in the female and with a suggestion of a curve; the abdomen small, elongate triangulate, moderately long petio-

late; the legs often darker in some small part; the wings at least relatively longer than in the female; the spotting in the cubital cell lighter or heavier than in the female; length slightly greater than in the female, the legs apparently longer than in the female.

GALL OF AGAMIC FORMS.—Usually monothalamous (polythalamous in *pezomachoides*). Fundamentally spherical tho often much distorted in surface outline. The thin lining of the larval cell constitutes the nutritive layer; the cell wall (lacking in most of *Acraspis*) constitutes the protective layer; the bulk of the gall (except in *Acraspis*) is made up of a thinly or densely fibrous or a more compact parenchyma layer which holds the larval cell centrally and, in a few species (including all of *Antron*), contains a second, unoccupied cavity; an outermost hardened layer (constituting the bulk of the gall in *Acraspis*) is the collenchyma layer; and the epidermal layer is usually naked or finely pubescent, in *Acraspis* becoming contorted into a faceted surface sometimes coated with long spines or wool-like processes. Attached by only a small point (and therefore easily separable) on a main vein, usually on the under surface (less often on the upper surface, rarely on the petioles or young twigs) of leaves of white oaks; known from every group of white oaks that occurs in the regions inhabited by these insects.

GALL OF BISEXUAL FORM.—Monothalamous. A small, thin-walled, hard-shelled, largely naked, roughly egg-shaped or simple seed-like cell; or a larger thin-walled, more succulent, irregularly bladdery capsule; in either case without well differentiated layers of tissue or unusual epidermal development and without a differentiated larval cell except the central cavity of the gall; always within young buds, often completely enclosed by the unopened bud; closely connected to the young or older twigs or (in adventitious buds) on the bark of the older trunks; on white oaks of the same species which harbor the agamic generation of the insect.

RANGE.—Known from North America from southern Canada to central Mexico, from Europe wherever oaks occur, and from the borders of Asia and Africa on the Mediterranean Sea; not known, but to be expected from the rest of Asia wherever oaks occur. Figure 7.

GENOTYPE.—*Cynips folii* Linnaeus. Designated by Westwood, 1840, Generic Synop.: 56. See the discussion under the European subgenus *Cynips*.

The genus is here divided into six subgenera, *Cynips*, *Antron*, *Besbicus*, *Philonix*, *Atrusca*, and *Acraspis*, under each of which the systematic and biologic data are presented.

Cynips subgenus **Cynips** Linnaeus
agamic and bisexual forms

Cynips Linnaeus, 1758 (in part), Syst. Nat. ed. 10, 1: 553. Linnaeus, 1789 (in part), Ent. faunae suecicae 3: 69. Westwood, 1840, Classif. Ins. 2: 127, 131. Westwood, 1840, Generic Synop.: 56. Hartig, 1840 (in part), Germar Ent. Zeit. 2: 185, 187. Schenck, 1865 (in part), Jahr. Ver. Nassau 17-18: 174, 178. Taschenberg, 1866 (in part), Hymen. Deutsch.: 141, 144. Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 364. Also of other authors.

Diplolepis Geoffroy, 1762 (only in part), Hist. Ins. 2: 308. Latreille, 1807, Gen. Crustac. et Insect. 4: 18. Dalla Torre and Kieffer, 1910 (in part only), Das Tierreich 24: 342. [NOT *Diplolepis* Geoffroy, 1762, whose type seems to be *Cynips rosae* Linnaeus, suggested by Karsch, 1880, Zeit. Gam. Naturh., and specifically designated by Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 365.]

Dryophanta Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 335. Mayr, 1871, Mitteleurop. Eichengallen: 35-39. Mayr, 1881, Gen. gallenbew. Cynip.: 9, 12, 36. Mayr, 1882, Europ. gallenbew. Cynip.: 35. Dalla Torre, 1893 (in part), Cat. Hymen. 2: 48-55. Kieffer, 1901, André Hymén. Europe 7 (1): 619. Dalla Torre and Kieffer, 1902 (in part), Gen. Ins. Hymen. Cynip.: 52. Kieffer, 1903, André Hymén. Europe 7 (2): 677. Also of many other authors.

Spathegaster of authors. For bisexual forms. [NOT Hartig, 1840, Germar Ent. Zeit. 2: 186 = *Neuroterus*.]

FEMALE.—The cheeks slightly enlarged behind the eyes (agamic forms) or not enlarged (bisexual forms); antennae of moderate length, with 13 or (rarely) 14 segments (agamic forms), with 14 distinct segments in bisexual forms; thorax of moderate size; parapsidal grooves continuous; median groove lacking; mesopleura (agamic forms) largely punctate and hairy, or mesopleura (bisexual forms) largely smooth and naked; abdomen smooth and naked except for the hairs latero-basally and for a microscopic pubescence on the posterior segments; hypopygial spine rather broad, rather drawn out at the ventral tip; tarsal claws of moderate weight, moderately toothed; wings always long, about 1.50 times the body in length (in both agamic and bisexual forms); the second abscissa of the radius only slightly curved at a point one-third from the tip, the tip of the vein with or without an expansion; the radial cell rather long and only moderately broad; the areolet of moderate size to small; all the cells without clouded patches or spots unless there is a mere trace of a patch at the base of the cubital cell; length 1.8 to 4.4 mm., the agamic insects varying from a small to a moderate size, the known bisexual forms of moderate size.

MALE.—Differs from the bisexual female as described for the genus *(q.v.)*; the eyes a bit larger than in the female but barely extending beyond the cheeks; antennae with 15 segments; all wing cells clear of spots and blotches.

GALL OF AGAMIC FORM.—Moderate sized to small, spherical or ellipsoid, in one species *(cornifex)* irregular horn- or club-shaped; largely smooth, entirely naked; filled with compacted, soft, and spongy fibers which show main fibers radiating from the centrally-placed larval cell; the spongy material considerable in the larger galls, reduced in smaller galls and very little in the smallest galls; the larval cell usually central, usually closely embedded in the spongy material, the cell inside a more or less distinct central cavity in two species *(disticha* and *cornifex).* Attached singly on the veins, usually on the undersurfaces of the leaves, on European white oaks.

GALL OF BISEXUAL FORM.—A seed-like or egg-shaped, pubescent cell in the adventitious buds on the trunks or younger stems of the oaks; or an irregularly constricted or subdivided cell on the leaves or in the buds; without a distinct larval cell; on the species of oak on which the corresponding agamic form occurs.

FIG. 14. KNOWN RANGE, SUBGENUS CYNIPS
Shading and figures indicate number of species known from each area.

RANGE.—Restricted to Europe, adjacent Asia Minor, and northern Africa; perhaps also represented further east in Asia (Fig. 14).

ORIGINAL DESCRIPTION.—Of *Cynips.* Linnaeus, 1758, Syst. Nat. ed. 10, 1: 553. CYNIPS. *Os* maxillis absque proboscide. *Aculeus* spiralis, saepius reconditus. *Translation:* With a biting instead of a sucking mouth; the sting spiral, often hidden.

Of *Dryophanta.* Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 335. *Dryophanta* m. Char. gen. — Kopf mit 5gliedrigem Kiefer und 3gliedrigen Lippentastern, Fühler 13—14gliedrig, rauhhaarig, das 1. Glied der Geissel länger als das 2.; Mesonotum punktirt, mit niederliegenden

Haaren bedeckt, hinten gerade abgestutzt, die Furchen der Parapsiden durchgehend; Schildchen ohne deutliche Grübchen an der Basis, Beine mit rauhen abstehenden Haaren versehen; Hinterleib an der Spitze mit zerstreuten Haaren (nicht wie bei *Cynips* mit dicht gedrängten, niederliegenden seidenartigen Härchen bekleidet); Flügel mit einem stark verlängerten, am Vorderrande offenen Radialfeld, die 2. Cubitalzelle an der Basis desselben liegend.

Typ. *Dryoph. Folii* = *Cynips Folii* L. . . . .

Translation. Dryophanta, new genus. Generic characters: Head with 5-segmented maxillary palps and 3-segmented labial palps, the antennae with 13 or 14 segments, roughly hairy, the third segment longer than the fourth; the mesonotum punctate, covered with recumbent hairs, distinctly truncate posteriorly, the parapsidal grooves complete; the scutellum without the usual foveae at the base; the legs covered with a rough coat of erect hairs; the abdomen with scattered hairs anteriorly (not with the dense, recumbent, and silky hairs found in *Cynips* [= *Adleria* Rohwer and Fagan]); the wings with a much lengthened, open radial cell, with an areolet lying at the base of that cell. Type: *Dryophanta folii* = *Cynips folii* Linnaeus.

SUBGENOTYPE.—Of *Cynips: Cynips folii* Linnaeus. Designated by Westwood, 1840, Generic Synop.: 56. Morice and Durrant, 1915, Trans. Ent. Soc. Lond. 1915: 431, state that Lamarck, 1801, chose *quercus-folii* Linnaeus as type of *Cynips.* Concerning this statement, Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53:364, write as follows: "With this we can not agree as we do not believe that Lamarck or most of the other old writers' examples are any more than illustrations of the various genera. They therefore can not be accepted as type designations by the International Code, which says, 'The meaning of the expression "select a type" is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type.' "—Whether the Lamarck or the Westwood designation is accepted, *folii* remains the subgenotype of *Cynips.*

Other designations of genotypes for *Cynips* are invalid: *Diplolepis bedeguaris* Fabricius (by Latreille 1810:436), *Cynips quercus-radicis* Fabricius (by Curtis 1840:688), *Cynips argentea* Hartig (by Ashmead 1903)—all unavailable because none of these was originally included. *Cynips gemmae* Linnaeus (designated by Karsch 1880) is said by Rohwer and Fagan (1917) to be a doubtful designation, and in any event is a later designation than Westwood's in 1840 *(folii).* Bradley, 1919, Trans. Ent. Soc. London 1919: 71, accepted the above-mentioned designation of *bedeguaris* by Latreille as fixing the type of *Cynips;* but Professor Bradley writes me (in litt. 9.15.28) that he now realizes that *bedeguaris* is not available because not originally included, and that he agrees with Rohwer and Fagan's interpretation, which we accept in the present paper, of *folii* as the type of *Cynips.*

Of *Dryophanta: Cynips folii* Linnaeus. Monobasic and original designation by Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 331, 335. Isogenotypic with *Cynips.*

This, the typical subgenus of *Cynips*, seems confined to Europe and the adjacent Mediterranean shores of Asia Minor and Africa. There it is the only subgenus of *Cynips* represented. Further collecting may show that the group extends eastward across the whole of Asia; but it is evident enough that the five American subgenera, altho they have had a common origin with European *Cynips*, are as distinct as their not inconsiderable period of geographic isolation would lead us to anticipate. The closest American relatives of the European *Cynips* are the Pacific Coast subgenera *Antron* and *Besbicus*.

European *Cynips* is known from eleven varieties which represent the geographic segregates of six species. The most unique of these, *Cynips cornifex*, is confined to a limited part of the Mediterranean area in Europe. The other five species probably range as far as oaks extend in Europe, and at least some of them occur in northern Africa and Asia Minor. Each of these five species was first described from central European material; but each of them may also have a distinct northern variety (only three of which are described to date) and one or more Mediterranean varieties (only one of which is described!).

Studies of the geographic distribution, the host isolation, and the phylogenetic origins of the European fauna cannot progress very far when they are based on as uniform an area as that which constitutes Central Europe, or on a single species of host, which is essentially the oak flora (*Q. Robur* and its minor variants: *Q. pedunculata, Q. sessiliflora, Q. pubescens,* etc.) in Central Europe. In America we have found the comparative study of groups of related varieties an unsurpassed means of interpreting biologic phenomena. The Central European fauna may offer similar possibilities if it is compared with its adjacent faunas.

It should be emphasized that the study of cynipid varieties must be based on insects as well as on galls. We have many cases among our American Cynipidae where the varietal characters are not evident from the galls alone, and the herbarium collections in vogue among European "Cecidologists" will contribute little toward phylogenetic studies until they are fortified by large series of insects representing (for the Mediterranean region) each of the species of oaks or groups of closely related oaks involved.

The distribution maps of the European species of *Cynips* will offer material for thought even if they are obviously incomplete summaries of what European collectors may have stored away in their local collections. The records that have been published are often unsatisfactory, for two reasons: they may name the country without giving more precise localities, and tho there may be a dozen such records for a given species in a given country, they can be represented on the maps by only a single dot; or, in a few cases, the published lists carry such precise locality records that a dozen collections may be cited from an area of not more than a few miles in extent. The maps as published may serve to show where it is most desirable to make additional collections or to make available the data from collections already in existence.

The six European species of *Cynips* represent three well-marked groups. One of these includes *folii* and *longiventris,* species which have insects that are practically indistinguishable in Central Europe, galls that are built on fundamentally the same plan, and bisexual forms which are almost identical as regards both the insects and their small, cell-like, bud galls. Three other species, *divisa, agama,* and *disticha,* are a unit in having lengthened abdomens (with *agama* nearer *folii* in this respect), more naked mesonota, smaller galls with much reduced spongy parenchyma, and bisexual galls (known for *divisa* only) located primarily on the leaf. *Cynips cornifex* represents a third group, its very distinct gall indicating some unique origin or divergence along the evolutionary path, altho its insect is close to the *divisa-agama-disticha* group of species.

All the Central European insects of *Cynips,* both in their agamic and bisexual generations, are strikingly alike, altho their galls are distinct enough. The group thus offers a good example of physiologic species, *i.e.* of species in which a physiologic quality (the gall-producing capacity) has mutated faster than any of the morphologic characteristics of the insects. An even more interesting situation is presented by the striking similarities which exist among the northern varieties of *folii, longiventris,* and *divisa.* If agamic insects alone were available, we would recognize the northern material as one species and the Central European as the only other species of European *Cynips.* With the help of the bisexual insects,

we might recognize a third species, because the bisexual insects of *divisa* in Central Europe are easily enough distinguished; but the situation remains as shown in the following diagram where similarities are indicated by arrows, the agamic insects by ♀̇, and the bisexual insects by ♀ ♂.

	Folii	*Longiventris*	*Divisa*	*Agama*	*Disticha*	*Cornifex*
Northern insects	♀̇ ↔	♀̇ ↔	♀̇			
Central and southern insects	♀̇ ↔	♀̇ ↔	♀̇ ↔	♀̇ ↔	♀̇ ↔	♀̇
	♀ ♂ ↔	♀ ♂	♀ ♂			

On the other hand, from galls alone, European *Cynips* would be granted six or seven species, which would recognize no distinctions (on galls alone!) between northern and more southern material. Graphically, this may be shown (where ⊕ is the gall) as follows:

	Folii	*Longiventris*	*Divisa*	*Agama*	*Disticha*	*Cornifex*
Northern galls	⊕	⊕	⊕			
	↕	↕	↕			
Central European galls	⊕	⊕	⊕	⊕	⊕	
	↕					
Southern galls	⊕					⊕

If we take into account *both* insects and galls, which should we use for establishing specific lines, and which for varietal lines? Our procedure may be determined by the fact that between the galls of the six types there are no intergrades, while between the northern and Central European insects there are numerous intergrades. This suggests that each northern insect has been derived by variation and geographic isolation from a Central European insect, and that the galls remain as indicators of the ancestry of these variants, *i.e.* that the galls in the subgenus *Cynips* should be taken to indicate the specific, and the insects the varietal lines of a natural classification. The conclusion finds abundant corroboration in our American experience with geographic variation; and European students are not likely to dissent with a solution that does no more damage than this to the previous classifications. The

situation, nevertheless, warrants the conclusion that a consideration of the insect morphology alone would have led to a highly artificial classification.

The bisexual forms are known for four of the varieties representing three of the species (*folii, longiventris,* and *divisa*) of European *Cynips.* The agamic galls appear in Central Europe in late June, maturing in August, the insects transforming into adults in September or October but delaying emergence until late in October, November, December, or warmer days in later winter. The eggs of these agamic females are layed in buds, the bisexual galls appearing in April or May in the adventitious buds on older branches, or on younger shoots, or on the tips of the leaves, depending on the place of oviposition of the agamic mother. In the uniformity of these four life histories we have an evidence of relationships which is stronger than that furnished by the few morphologic characters available for delimiting the subgenus; and we may confidently predict that the bisexual generations of the other varieties, with the possible exception of *C. cornifex,* will prove nearly identical with the bisexual forms already known. There is, however, a possibility that some of the most southern varieties may have only a single, agamic generation in a year, without alternation of generations—a condition evidently existing among some of our more southern American Cynipidae.

In addition to the above-mentioned, bisexual *Cynips,* there is another, *Cynips schlechtendali* Kieffer, that seems unrecognizable to me at this time. The data for this insect are given directly below, instead of in place with the known species of *Cynips,* for *schlechtendali* is not more than a bisexual form of *agama* or *divisa* (the only Central European *Cynips* for which bisexual forms are not known), if indeed it is not a synonym of one of the other bisexual forms.

Dryophanta sp.? Schlechtendal, 1891, Jahrb. Ver. Zwickau, 1890: 341 (♀, ⊕) (acc. Kieffer, 1901, Ann. Soc. Ent. France 1901:435).

Dryophanta Schlechtendali Kieffer, 1901, Ann. Soc. Ent. France, 1901; 435 (♀, ⊕).

Dryophanta Schlechtendali Houard, 1908, Zoocécid. Europe 1: 261.

Diplolepis Schlechtendali Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 353, 756, 783. Kieffer, 1914, Ins. Mitteleur. 3 (3): 44, 63. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nord-europas: 231. Tavares, 1928, Broteria 25: 52.

ORIGINAL DESCRIPTION. Kieffer, 1901, Ann. Soc. ent. France 1901: 435. Dryophanta Schlechtendali, n.sp. Surface finement bosselée, sans poils vésiculeux; galle conique. Sur *Q. pedunculata* (von Schlechtendal, 1891). Diffère de *D. verrucosa,* selon Schlechtendal, par les pattes d'un jaune sombre.

Translation. Dryophanta Schlechtendali, new species. The surface of the gall finely embossed, without vesicular hairs; the gall conical. On *Quercus pedunculata,* according to Schlechtendal 1891. The insect differs from *Dryophanta verrucosa,* according to Schlechtendal, in its dull yellow legs.

All that is known of this insect is contained in Schlechtendal's record of its occurrence in Ober-Lausitz in Germany, and in the description quoted above. Kieffer, however, was forced to group the bisexual forms of the entire subgenus *Cynips* in the key of his 1901 monograph, with the statement that the insects are indistinguishable; and Dalla Torre and Kieffer had to do this in the 1910 volume of Das Tierreich. Even Mayr (1882) stated he was not able to distinguish the insects. If these authors were ignorant of the differences that actually exist between these bisexual forms in the subgenus, I question their authority to distinguish an insect (*schlechtendali*) which they had never seen! It is, moreover, to be noted that the legs of the forms *similis* and *verrucosa* among European *Cynips* are already a dull yellow and light piceous, and are not to be distinguished from *schlechtendali* on this character. Unless authentic material of *schlectendali* is actually in existence, there seems to be no useful purpose served in keeping this name out of the list of unrecognizable binomials in Cynipidae.

There are more or less detailed histologic studies available for the galls of all the species of European *Cynips.* In summary it may be noted that Fockeu's study (1889, Hist. Galles: 23) showed there are common histologic structures in the galls of *folii, longiventris,* and *divisa,* again bearing witness to the natural affinities of the group. These common characters in the galls of the three are: (1) Slight irregularities on the surfaces. (2) Occasional stomata in the epidermal coverings especially basally. (3) Lack of starch in the parenchyma in the agamic galls of *Cynips* [this needs verification!] altho it is present in *Neuroterus* galls, and the presence of an abundance of tannin. (4) The presence of branching, cylindric, or prismatic cells in the parenchyma. (5) Fibro-vascular bundles massed in places to form networks similar to those

in the leaves. (6) A poorly differentiated protective zone. (7) The spherical form of the galls and their attachment to the veins of the leaves.

Beyerinck's analysis (1883) of the development of both the agamic and bisexual galls of *Cynips folii* are detailed under the variety *folii.*

In the pages that follow, the bibliographies given for each species include only such papers as I have actually seen and summarized in the account of the species, except in those few cases where the record is given on the authority of ("acc.") another work which is duly cited. It has been impossible to secure as complete a library of European literature as I have for the American Cynipidae, but the summaries can be offered as fair accounts of our knowledge of European *Cynips.*

To the student who is confused by the hundreds of European titles on the gall wasps, we may render some service by pointing out that our knowledge of that fauna is largely contained in a short list of eight papers. Hartig in 1840 (Germar Ent. Zeit. 2:176-209) contributed the original descriptions of many species and, more important, gave us the foundation for the generic classification on which we are building today. Mayr in 1870 (Die Mitteleuropaischen Eichengallen), 1881 (Die Genera der Gallenbewohnenden Cynipiden), and 1882 (Die Europaischen Arten der Gallenbewohnenden Cynipiden) extended Hartig's generic arrangement with a noteworthy regard for biologic significances. Kieffer (1901-1903, Les Cynipides in André Hymén. Europe 7 (1-2) gave us a critical compilation of all the then-available taxonomic and biologic data on European Cynipidae. The several compilations which have followed in the last twenty-five years have contributed little to the advancement of our knowledge, if they are not chiefly responsible for having discouraged fresh investigations of the group. Even the Dalla Torre and Kieffer (1910) volume in Das Tierreich can be shown to have been drawn, as far as European Cynipidae are concerned, with few additions and no critical revision from Kieffer's 1901 monograph, or even more literally in places from Mayr's earlier papers.

Two papers on the life histories of European Cynipidae, Adler's 1881 contribution (Zeit. wiss. Zool. 35:151-246) and its confirmation by Beyerinck (1883, Ver. Akad. Amsterdam

22:1-198) are the bases of our knowledge of alternation of generations among the gall wasps. Such studies as Fockeu's (1889, Hist. Galles) and several others in gall histology are superior to the work we have done in America. Beyerinck (1883) and Paszlavzsky (1882-1883) studied the early development, or what might be called the embryology of the gall structure, an aspect of our problem which has hardly yet been considered in America.

If the present review of European *Cynips* serves to clear the way for further work on the group, or if it serves to awaken interest in a reconsideration of the Central European fauna in the light of the more northern and the more southern faunas, and even of the related American subgenera, then this part of our study shall have accomplished its purpose.

Cynips (Cynips) folii Linnaeus

agamic and bisexual forms

AGAMIC FEMALE.—The entire insect rich rufous and piceous (Mediterranean and Central Europe) to entirely black (more northern Europe); the head distinctly narrower than the rather robust thorax (Mediterranean and Central Europe) or practically no narrower (more northern Europe); the mesonotum largely punctate and hairy (Mediterranean and Central Europe) or largely smooth and naked (more northern Europe); the abdomen not more than twice again as long as high, the tip of the second segment approaching the tip of the abdomen dorsally; the tip of the second abscissa of the radius not bent, with or without a distinctly triangulate enlargement; length 2.1 to 4.4 mm. in three varieties.

The central European variety *folii (q.v.)* is nearly identical with *C. longiventris longiventris* and close to the other varieties of *Cynips* in the same region; the more northern variety *atrifolii* is very near *C. longiventris forsiusi* and *C. divisa atridivisa* of that region.

BISEXUAL FEMALE AND MALE.—As described for the genus and subgenus *(q.v.)*. Very similar to the bisexual forms known for other species of European *Cynips*. Differing in having the legs a brighter, clearer yellow and the mesonotum and mesopleuron entirely smooth and shining.

AGAMIC GALL.—Rather large, spherical, filled with soft and spongy fibers. Up to 30. mm. in diameter. Externally smooth and naked, or set with small, irregular papillae; fresh specimens green, yellowish, or red in color, becoming yellowish brown or russet brown on drying; the outer shell rather thin, readily distinguished from the spongy interior of the gall; this spongy material filling all the gall, but consisting large-

ly of much-branched fibers with a considerable amount of small, open space, giving a suggestion of main fibers radiating from the center as in the galls of the American subgenus *Atrusca.* The larval cell usually central, oval, averaging 3.5 by 4.0 mm., with a distinct wall but inseparable from the spongy filling of the gall, the spongy material directly outside the larval cell, sometimes irregularly compacted and as hard as the cell wall itself. Attached to the median or lateral veins by only a slight point, on the leaves of numerous species of European white oaks.

BISEXUAL GALL.—A small, egg-shaped, thin-walled cell originating in the adventitious buds of the older or younger oak stems. The cells up to 3.0 mm. in length, their surfaces microscopically puberulent, at first red or violet, finally blackened; the entire gall inside the thin shell occupied by the larval cell. Sessile on the old bark near the base of the trunks, less often on the younger stems, but often on the older bark of large stems, a third to a half enclosed by the normal bud scales. Known from *Quercus pedunculata, Q. sessiliflora,* and *Q. pubescens.*

RANGE.—Probably wherever oaks occur in Europe, Asia Minor, and northern Africa, with the four described varieties, *atrifolii, folii, flosculi,* and *ilicicola,* confined to more northern, central, and Mediterranean Europe and Spain respectively (fig. 15, 16).

The galls of the typical variety of this species are among the commonest and best-known of Central European Cynipidae. This was one of the five species of oak galls known to Linnaeus (1758), and later workers on cynipid structure and biology, and on gall histology and embryology have usually included this species in their studies.

The variety *folii* ranges over the whole of Central Europe, being replaced in the Mediterranean area of Europe and Africa by a very similar insect, variety *flosculi* (better known from its agamic form *pubescentis*) which has certainly been derived from the same stock as typical *folii.* The insects of the two are so close that most authors have considered them inseparable, and no one, except Tavares (1928), has described more than color differences which, I believe, are not invariable enough for the separation of even the majority of the specimens. I find the smooth foveal groove, the smoother anterior portion of the scutellum, and the enlarged tip of the second abscissa of the radius of *flosculi* will serve for the recognition of the insects I have seen. The agamic galls of *folii* and *flosculi* are quite distinct (except in certain transition areas), and this seems to have been the basis on which determinations

have been made heretofore. These galls, however, differ only in details of size, color, and their degree of hardness and there can be no objection on these grounds to considering the two as varieties of a single species. In first describing the form *pubescentis* Mayr (1881) suggested that (translating): "*D. pubescentis* . . . should perhaps be considered only a subspecies of *D. folii*"—a suggestion which, if it had been followed, would have given us a better understanding of the common ancestry of the two and of the geographic isolation which must be chiefly responsible for their preservation as genetic entitites.

The variety *folii* occurs on *Q. pedunculata* and *Q. sessiliflora* thruout most of its range. In its more southern extension it undoubtedly occurs on *Q. pubescens* (acc. Straton 1894 and Connold 1902 in England, Houard 1914, Marcellia 13, in Central France, and particularly acc. Cotte 1910 in Provence). Further collections made in areas where both *folii* and *flosculi* occur on *Q. pubescens* should be studied to ascertain how much interbreeding may go on where the two enjoy neither host nor geographic isolation.

As far as our records go, the variety *folii* reaches the Mediterranean coast only in Provence, unless Gräffe's record (1905) for Triest proves correct. There are no substantiated records for *folii* south of the Pyrennes or the Alps. *Flosculi* on the other hand does not get north of these mountain ranges, altho it does occur in a restricted Mediterranean strip in Provence, and farther east it extends thru Austria and Bohemia as far as the boundaries of German Silesia. It is notable that insects of *folii* and *flosculi* in my collection are all readily separated by the characters given above except for the material which comes from Moravia, Bohemia, and southern Silesia. Among nearly four hundred insects of *folii* which I have from localities in Denmark, France, and Central Germany, not a single one shows appreciable variation toward *pubescentis*. But out of 21 adults from Moravia (Baudys coll.), one shows the radial vein and another the scutellum typical of *flosculi*. One of my three insects from Dresden (southern Silesia) has a distinctly bent tip to the radial vein. All of the Moravian material is unusually dark in color. A Mayr specimen (determined as *scutellaris*) from Vienna also tends toward *flosculi* in its wing venation.

In brief, *folii* and *flosculi* are distinct enough where there are considerable barriers that isolate them, but in the few regions in which they do come together one finds some of the individuals looking like hybrids of the two.

Concerning the gradation of *folii* into the northern variety *atrifolii*, the insects which I have from Denmark (Hoffmeyer coll.) include 329 which are typical *folii*, 8 which are *atrifolii*, and 32 which intergrade between the two. *Atrifolii* is nearly black and very small, with a naked mesonotum and a naked spot on each mesopleuron.

Schmidt (1907) records the rearing of one specimen of *folii* from southern Silesia "with very short wings." Whether this represented a deformed specimen or a true mutation matching the many short-winged insects of this genus in America, is not determinable from the published record.

The life history of the variety *folii* is known in considerable detail. The alternate generation of the variety *flosculi* has been recognized by analogy with *folii*. The detailed data are given under each variety. The alternate form of the northern *atrifolii* is not yet available, but it undoubtedly will prove similar to that of *folii*.

There are numerous records for galls "resembling" *folii* on southern European oaks that are in many cases distinct from the Central European, *Q. Robur* group of oaks. Our experience with American Cynipidae would justify the prediction that there are several host-limited varieties of *folii* still to be recognized in Mediterranean Europe, eastern Asia, and northern Africa. The published references which I believe should be re-determined on the basis of good series of insects (as well as on galls) are as follows:

Dryophanta scutellaris Rolfe, 1881, The Ent. 14:56 (*Q. lusitanica Turneri* at Kew Gardens).

Dryophanta folii Kieffer, 1901, André Hymén. Europe 7(1): 87 *(Q. fastigiata)*. Darboux and Houard, 1901, Zoocécid. Europe: 297, 354, 355 *(Q. fastigiata, Q. toza, Q. virgiliana)*. Darboux and Houard, 1902, Zoocécid. Hilfsbuch: 39, 43. Houard, 1906, Marcellia 4: 143 (*Q. toza* record only). Houard, 1908, Zoocécid. Europe 1: 265, 268, 278, 318 (incl. *Q. macranthera* record).

Diplolepis quercus-folii Dalla Torre and Kieffer, 1910, Das Tierreich 24: 346 (certain hosts only), 776, 792. Houard, 1922, Marcellia 18: 9 (*Q. Mirbecki* in Algeria). Houard 1922, Zoocécid. Afrique, etc. 1: 130, 133, 136 *(Q. Mirbecki, Q. macranthera, Q. infectoria)*. Hedicke, 1922, Konowia 1: 35 (*Q. haas* at Dahlemer Bot. Garten).

Tavares, 1928, Broteria 25: 35 (Spain, *Q. Toza* and *Q. lusitanica* records only).

In addition, I question the records for the variety *flosculi* (incl. form *pubescentis*) on oaks other than *Q. pubescens* and its immediate relatives. I have, however, not attempted to distinguish the doubtful references except by question marks in the bibliography of *flosculi,* and in the revival of Kieffer's *ilicis* as a distinct variety of *folii.*

While it is simple enough to understand the existence of distinct varieties of *folii* in northern, central, and Mediterranean Europe, and of the host-limited variety in Spain, the nomenclatorial problem is complicated enough to make one question the fundamental bases of our International Code. The identity of the Linnean *folii* must be based on the original description or on definite knowledge of the source of Linnaeus' material, since the Linnean material of *Cynips* seems no longer in existence. That Linnaeus had some Swedish material of this species is asserted in his Fauna Suecica (1746: 947, and 1789, Ent. Faunae Suecicae 3:71) but it is just as certain that he was in a position to have received Central European material from many sources. The possibility of his having received the more southern European variety seems more remote, since we have so few collections of that insect even today, but even this cannot be settled on the basis of definite data from the Linnean publication.

The original description of the insect (quoted under the variety *folii*) is inadequate unless in its reference to a "*Cynips thorace lineato* . . ." which, I take it, must be translated to mean a black *Cynips* with a striped thorax. This might apply to the rufous and black insects of either Mediterranean or Central Europe, but it would not apply to the entirely black insect of more northern Europe. The Linnean description of the gall is also inadequate unless the "avellanae magnitudine" (size of a filbert) is noted as too small for some of the Central European galls—but it is still a fair average for unselected lots of material from that region. The later description in the Linnean Entomologia Faunae Suecicae is more detailed, and it seems to apply to an insect darker than the Central European but not as black as the northern European variety, so it is possible that Linnaeus' Swedish material was hybrid between the two.

Under these circumstances, it surely is not unreasonable to appeal to usage to preserve the current application of the name *folii.* Since 1872 no European entomologist has applied the name to anything but the Central European insect, except in a few cases of outright mis-determinations which were not confusions of nomenclature. It is the Central European insect which carries the name *folii* in the present paper.

The second oldest name applied to the present species is Fourcroy's *Diplolepis quercus* (1785), which was a binomial (acc. Rohwer and Fagan, 1917:365) created for Geoffroy's *Diplolepis No. 1* (1762). The name *quercus* was never revived until Dalla Torre and Kieffer (1910) applied it to the Mediterranean variety of *folii,* probably because they discovered that Mayr had cited Geoffroy's *Diplolepis No. 1* in the synonomy of that southern variety. According to the title page of the earliest edition of Geoffroy, that author drew his material from near Paris where, we now find, only the typical *folii* occurs. Geoffroy himself believed he had the true Linnean *folii* in his *Diplolepis No. 1,* as he indicated in the Supplement to a later edition of the Histoire des Insectes (1799, Vol. 2:721). It seems, then, that Fourcroy's *quercus,* which was Geoffroy's *Diplolepis No. 1,* was a synonym of *folii,* and I am returning to Mayr's *pubescentis* as the correct name of the agamic form of the southern variety *flosculi.*

Incidentally, the name *flosculi* (1868) for the bisexual form of this Mediterranean variety is older than the name *pubescentis* (1881) applied to the agamic form, and it is consequently the correct name for the variety, even tho most of us will find it convenient to continue to refer to the two forms by their particular names. This is one justification for the system of quadrinomials which I have employed in all of my papers for the alternating generations of Cynipidae.

In the synonomy of typical *folii* I have placed Oliver's *scutellaris* as Mayr placed it in 1881, and as practically all later authors have interpreted it. It would appear from the original publication of *scutellaris* that Oliver's material may have come from Manosque in Provence, an area which (acc. Cotte, 1912) has both the Central European and Mediterranean varieties of this species in it. We cannot, therefore, be more certain of Oliver's *scutellaris* than we are of Linnaeus' *folii,* but again, in the absence of type material, we seem justified in fol-

lowing usage. For all the other synonomy concerning which European authors have been in complete accord, I have also been able to accept current usage.

Cynips folii variety **folii**

agamic form **folii** Linnaeus

Figures 15, 74-76, 79-81, 88, 91, 93, 94, 107, 113-117, 125-126

——[no name] Réaumur, 1737, Mém. Ins. 3: 450, pl. 39 fig. 13-17.

Cynips Quercus folii Linnaeus, 1758, Syst. Nat. ed. 10, 1:553 (♀, ⊕). Linnaeus, 1767, Syst. Nat. ed. 12, 1 (2) :918. Linnaeus, 1789, Ent. Faunae Suecicae 3:71. Turton, 1806, Linné Syst. Nat. 3:408. Stephens, 1829, Cat. Brit. Ins. :402. Dahlbom, 1842, Onychia och Callaspidia, suppl. page 5 no. 58.

Diplolepis No. 1 Geoffroy, 1762, Hist. Ins. 2:309, pl. 15 fig. 2 (♀, ⊕). Geoffroy, 1799, Hist. Ins., nouv. ed., 2: 309, 721, pl. 15 fig. 2.

Diplolepis quercus Fourcroy, 1785, Ent. Paris 2: 391 (♀, ⊕) [acc. Dalla Torre, 1893, Cat. Hymen. 2:54]. Err. det. Hedicke, 1915, Zeit. Insektenbiol. 11:23?.

Diplolepis Quercus folii Olivier, 1791, Enc. Méth. 6:280?

Diplolepis scutellaris Olivier, 1791, Enc. Méth. 6:282.

Diplolepis unedoniformis D'Anthoine, 1794, Nouv. Journ. Phys. 1:36, fig. 6 [acc. Kieffer, 1898, Wiener Ent. Zeit. 17:265, authority for the synonomy].

Cynips gallae-cerasiformis D'Anthoine, 1794, Nouv. Journ. Phys. 1:38, fig. 10 [acc. Kieffer, as above].

Cynips quercus folii Latreille, 1807, Gen. Crustac. et Ins. 4:18. Latreille, 1810, Consid. génér. Ins.:436. Dahlbom, 1837, Skandinav. Ins.:296. Westwood, 1840, Classif. Ins. 2:127, 131. Westwood, 1840, Generic Synop.:56 (genotype). Fargeau, 1846, Hist. Ins. 4:63. Lacaze-Duthiers, 1850, Ann. sci. nat. Zool. (3) 14:23-26 (gall only; fig. 1-6 at least is an inquiline). Osten-Sacken, 1862, Stettiner Ent. Zeit. 23:80. Kaltenbach, 1874, Pflanzenfeinde :665. Leunis, 1886, Thierkunde 2: 264, fig. 247a. Schenkling, 1896, Ill. Wochenschr. Ent. 1:217, 233, fig. 1a.

Cynips scutellaris Latreille, 1810, Consid. génér. Ins.: 436.

Cynips folii Hartig, 1840, Germar Ent. Zeit. 2: 177, 179, 181, 184, 187, 197, 198 (♀, ⊕). Hartig, 1841, Germar Ent. Zeit. 3: 349. Hartig, 1843, Germar Ent. Zeit. 4: 397, 398, 406. Schenck, 1865, Jahr. Ver. Nassau 17-18: 148, 152, 158, 160. Reinhard, 1865, Berl. Ent. Zeit. 9:2, 6. Taschenberg, 1866, Hymen. Deutschl.: 144. Smith, 1867, Ent. Month. Mag. 3: 183. Marshall, 1867, Ent. Month. Mag. 4: 6. Schlechtendal, 1870, Stettin. Ent. Zeit. 31:379 (⊕). Cameron, 1880, Ent. Month. Mag. 16: 266. Sharp, 1895, Cambridge Nat. Hist. 5:530. Dalla Torre, 1898, Cat. Hymen. 5: 176.

Cynips scutellaris Ratzeburg, 1848, Ichneum. Forstins. 2: 180, 218. Ratzeburg, 1852, Ichneum. Forstins. 3: 224, 254. Schenck, 1865,

Jahrb. Ver. Nassau 17-18: 157, 175, 178, 223, 226, 250 (♀, ⊕). Reinhard, 1865, Berl. Ent. Zeit. 9:6. Hoffer, 1890, Jahresber. Steiermärk. Landes-Ober. 39 [acc. Wachtl, 1890, Wiener Ent. Zeit. 9: 267]. Thieme, 1897, Ill. Wochenschr. Ent. 2: 359, 366, fig. d. Stefani, 1904, Marcellia 3:68.

Cynips Quercus-folii Newman, 1868, The Ent. 4:77. Newman, 1874, The Ent. 7:248.

Dryophanta Folii Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 336.

Dryophanta scutellaris Mayr, 1871, Mittel-europ. Eichengallen: 35, pl. 5 fig. 48 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 688, 708, 710, 714, 715, 722. Mayr, 1874, Ver. zoo.-bot. Ges. Wien 24: 37, 60, 91, 97, 98. Rudow, 1875, Archiv. Naturg. Mecklenburg 29: 32, 55, fig. 1. Mayr-Fitch, 1876, The Ent. 9:121, fig. 48. Wachtl, 1876; 6, 21, 23, 25. Adler, 1877, Deut. Ent. Zeit. 21: 238 (♀, ⊕, biol.). Fitch, 1877, The Ent. 10:27. Anon., 1877, Ent. Month. Mag. 14: 44. Katter, 1877, Ent. Nachr. 3: 153. Lichtenstein, 1877, Bull. Soc. Ent. France 1877: 91. Katter, 1878, Ent. Nachr. 4:6. Mayr-Fitch, 1878, The Ent. 11:226. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28:318. Uhlmann, 1880, Mitt. Schweiz. Ent. Ges. :29. Adler, 1881, Zeitschr. wiss. Zool. 35:186, pl. 11 fig. 14, pl. 12 fig. 5 (♀, ⊕, biol.). Adler, 1881, Ent. Nachr. 7:122. Mayr, 1881, Gen. gallenbew. Cynip.:36. McLachlan, 1881, Ent. Month. Mag. 17:259. Adler-Lichtenstein, 1881, Génér. Altern.: 48-50, pl. 11 fig. 14, pl. 12 fig. 5 (♀, ⊕, biol.). Rolfe, 1881, The Ent. 14:54. Rolfe, 1883, The Ent. 16:30. Fockeu, 1889, Hist. Galles: 23. Eckstein, 1891, Pflanzengallen und Gallentiere: 7, fig. 40. Dalla Torre, 1892, Ber. nat. Ver. Innsbruck 1891-92: 93. Cameron, 1893, Brit. Phytoph. Hymen. 4:66. Adler-Straton, 1894, Altern. Gener. : XXXIII, XXXIV, 60-63, pl. 2 fig. 14, pl. 3 fig. 5 (♀, ⊕, biol.). Riley, 1895, Science n.s.1:463. Schenkling, 1896, Ill. Wochenschr. Ent. 1:219. Dalla Torre, 1898, Cat. Hymen. 5: 297, 310, 326, 342. Giard, 1901, Bull. Soc. Ent. France 1901: 47. Connold, 1902, Brit. Veget. Galls: 306. Hennequy, 1904, Les Insectes: 217, pl. 3 fig. 9. Connold, 1908, Brit. Oak Galls, 6, 18, 23, 48, 115, 132, pl. 1, 44, 45 (⊕). Küster, 1911, Die Gallen der Pflanzen: 363.

Cynips Folii Newman, 1874, The Ent. 7:251. Thomson, 1877, Opus. Ent. 8:790.

Dryophantha scutellaris Wachtl, 1876: 16.

Dryophanta folii Mayr-Fitch, 1876, The Ent. 9: 149. Fletcher, 1880, The Ent. 13:12. Fletcher, 1880, Ent. Month. Mag. 16:270. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀). Beyerinck, 1883, Ver. Konig. Akad. Amsterdam 22:8, 15, 20, 24, 27, 32, 37, 94-122, pl. 3 fig. 35, 36, 44-47, 49-53, pl. 4 fig. 54-58 (⊕, biol., histol.). Paszlavszky, 1883, Wiener Ent. Zeit. 2:129-132, 171-173. Fockeu, 1889, Hist. Galles: 45, 83-91, fig. 17, 18 (⊕, histol.). Hieronymus, 1890, Jahresber. Schlesisch. Ges. 68: exc. 169, 183 (⊕, histol.). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890:32. Liebel, 1892, Ent. Nachr. 18:272, 274. Dalla Torre, 1892, Ber. nat. Ver. Innsbruck 1891-92: 91, 147. Cameron, 1893, Brit. Phytoph. Hymen. 4: 122, pl.

1 fig. 6, pl. 16 fig. 2 (♀, ⊕). Dalla Torre, 1893, Cat. Hymen. 2:50. Schenkling, 1896, Ill. Wochenschr. Ent. 1:141. Riedel, 1896, Gallen und Gallwespen: 21, 41. Bignell, 1897, Ent. Month. Mag. 33:55. Appel, 1898, Schriften Physikal.-ökon. Ges. 39:96. Dalla Torre, 1898, Cat. Hymen. 5:100, 294, 302, 305, 333, 334. Kieffer, 1898, Wiener Ent. Zeit. 17:265. Kieffer, 1899, Bull. Soc. Rouen 34: 98. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 3-8. Oudemans, 1900, Nederland. Ins.: 749, fig. 502(IIa). Küster 1900, Flora 87: 155. Cameron, 1901, The Ent. 34:272. Kieffer, 1901, André Hymén. Europe 7 (1): 15, 28, 29, 32, 123, 159, 174-177, 184, 193, 195, 225, 630, pl. 4 fig. 1, 2, 9, 10, pl. 18 fig. 6, 6a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 444. Darboux and Houard, 1901, Zoocécid. Europe: 340, fig. 605, 606. Darboux and Houard, 1902, Zoocécid. Hilfsbuch: 41. Kieffer, 1902, Bull. Soc. Metz 22:9. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Kieffer, 1903, André Hymén. Europe 7 (2): 678. Blösch, 1903, Mitt. Schweiz. Ent. Ges. 11:48, 51. Ross, 1904, Gallenbild. der Pflanzen: 14, 26, fig. 2a, 5 (♀, ⊕). Rossig, 1904, Von welchen Organen . . . :9, 11, 12, 37, 48, 49, fig. 20, 21. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 574, 579. Gräffe, 1905, Boll. Soc. nat. Triest 23:29, pl. 1 fig. 9. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55:546. Cobelli, 1905, Verh. zoo.-bot. Ges. Wien 55:599. Houard, 1906, Marcellia 4: 143. Vogler, 1906, St. Gallen Jahrb. natw. Ges. 1905:335. Brehm, 1906, Marcellia 4: 182. Reijnvaan and Doctors, 1907, Marcellia 5: 142. Darboux and Houard, 1907, Galles de Cynipides: 236, pl. 21 fig. 3, 4 (⊕). Schmidt, 1907, Zeit. Insektenbiol. 3:345, 347. Sajo, 1907, Prometheus 18: 436, 438. Fortwaengler, 1907, Zeit. Insektenbiol. 3: 128. Schmiedeknecht, 1907, Hymen. Mitteleuropas: 397, 398. Connold, 1908, Brit. Oak Galls: 18, 157. Houard, 1908, Zoocécid. Europe 1:253, fig. 403, 409. Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 102, 104. Trotter, 1909; Marcellia 7: 167-174 (histol.). Houard, 1909, Marcellia 8:69. Noury, 1909, Bull. École Normale Rouen 1909:1. Cotte, 1910, Marcellia 8:154. Riedel, 1910, Gallen und Gallwespen: 9, 14, 24, 43, 81, 90, 94, pl. 6 fig. 31. Schulz, 1911, Festschr. Ver. Cassel 1911: 159. Weidel, 1911, Flora (2) 2:316-317, fig. 27. Küster, 1911, Die Gallen der Pflanzen: 42, 82, 161, 212, 214, 236, 298, 353, 382, 398, 399, fig. 75, 122b, 122c. Dieroff, 1911, Bericht ent. Vereins Lepid. 30:37. Swanton, 1912, Brit. Plant. Galls: 32, 38, 39, pl. 22 fig. 6-8 (⊕). Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70:239, 289, 304. Trotter, 1923, Marcellia 19: 127. Larue, 1928, Bull. Soc. Linn. Lyon 1928:125.

Dryophanta scutellarius Bignell, 1879, The Ent. 12:62.

Cynips (Dryophanta) scutellaris Karsch, 1883, Die Insektenwelt: 214.

Dryophanta pubescentis err. det. Beyerinck, 1883, Ver. Konig. Akad. Amsterdam 22:94.

Cynips Q. folii Packard, 1890, 5th Rpt. U.S. Ent. Comm.: pl. 15 (♀).

Folii-wespe Eckstein, 1891, Pflanzengallen und Gallentiere: 34, 54, fig. 52 (♀).

Dryophanta foli Cameron, 1893, Brit. Phytoph. Hymen. 4: 6, 27.

Dryophanta taschenbergi form folii Oudemans, 1900, Nederland. Ins. :33, fig. 26.

Dryophanta taschenbergi-folii Bayer, 1909, Verh. zoo.-bot. Ges. Wien 59:119. Bayer, 1910, Marcellia 9:92, 99.

Diplolepis quercus-folii Dalla Torre and Kieffer, 1910, Das Tierreich 241: 344, 346, 606, 623-625, 762, 783, 786, 789, fig. 59, 60 (♀, ⊕). Houard, 1912, Marcellia 11:33, 109. Cotte, 1912, Galles de Provence: 193. Borcea, 1912, Zoocecid. România :80. Houard, 1913, Marcellia 12:106. Kieffer, 1914, Ins. Mitteleurop. 3 (3): 14, 33, 35, 45, 63, 69, 70, 71, fig. 11, 30, pl. 2 fig. 5. Bayer, 1914, Moravské Hálky: 60, 73, 76. Houard, 1914, Marcellia 13:25, 44. Hedicke, 1915, Zeit. Insektenbiol. 11: 22, 23, 118. Houard, 1915, Marcellia 14: 99. Ross, 1916, Pflanzengallen Bayerns: 67, fig. 215A, B. Houard, 1919, Marcellia 16:131. Houard, 1919, Marcellia 17:10. Tavares, 1920, Mem. Soc. Portug. Zool. 4:58. Ross, 1922, Deutsch. Ent. Zeitschr. 1922:293. Houard, 1922, Zoocécid. Afrique, etc. 1:101. Houard, 1922, Marcellia 19:51. Ross, 1922, Bayerisch. Bot. Ges. 17: 127. Tavares, 1924, Broteria 21:10. Hoffmeyer, 1925, Ent. Meddel. 16:7. Baudys, 1925, Publ. Inst. Phytopath. Brno C 39:26, 28. Baudys, 1926, Bull. École Supér. Brno C 7: 35. Baudys, 1926, Bull. École Supér. Brno C 8: 12, 13. Jaap, 1927:177. Ross and Hedicke, 1927, Pflanzengallen Mit. und Nordeuropas: 228, fig. 139, 140. Tavares, 1928, Broteria 25:34, fig. 39 and pl. 3 fig. 1, 3, 4 (*Q. Robur* and *Q. pedunculata* records at most).

Dryophanta Taschenbergi form *folii* Swanton, 1912, Brit. Plant Galls: 168.

Diplolepis folii Kieffer, 1914, Ins. Mitteleurop. 3 (3) : 10, 20, 31. Hedicke, 1922, Deutsch. Ent. Zeitschr. 1922: 276. Bischoff, 1927, Biol. Hymen. :119.

Diplolepis quercus folii Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66:103. Baudys, 1916, Verh. zoo.-bot. Ges. Wien 66:79. Fahringer, 1921, Zeit. wiss. Insektenbiol. 16:232. Fahringer, 1922, Zeit. wiss. Insektenbiol. 17: 45. Baudys, 1923, Casopis 20: 65. Baudys 1926, Bull. École Supér. Brno C 7:42, 43.

Cynips quercus-folii Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 364, 365.

Dryophanta quercus-folii Fagan, 1918, Amer. Nat. 52:156.

Cynips folii form *folii* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

Dryophanta Quercus folii Trotter, 1923, Marcellia 19:144.

[*Diplolepis quercus* of authors (NOT Fourcroy) is *Cynips pubescentis* (Mayr)].

FEMALE.—Nearly identical with the Central European *Cynips longiventris longiventris*, differing in its larger size and more robust body, and in the scutellum which is as rugose anteriorly as posteriorly. Differing from other varieties of *folii* as follows: Body rich rufous with considerable piceous and black, the insect generally darker than *pubescentis;* the entire mesonotum heavily punctate and hairy, more so

than in *pubescentis;* the anterior parallel and lateral lines broad, smooth, naked, prominent; the scutellum as rugose anteriorly as posteriorly; the foveal groove prominently rugose at least toward the middle; the mesopleura entirely punctate and hairy; the tip of the second abscissa of the radius not enlarged or bent, at the most with a slight, triangulate enlargement; the length 2.8 to 4.0 mm., averaging nearer 3.5 mm. Figures 74-76, 78-81, 88, 91, 93, 94, 107.

GALL.—Dried galls soft and spongy, large, up to 30. mm., but usually between 10. and 30. mm. in diameter; fresh galls regularly spherical, but dried galls often much shrivelled and distorted in shape; smooth and naked or rather closely set with small, irregular, blunt papillae; younger galls green, yellowish, and red, older galls becoming light or dark russet brown; on the leaves of *Q. pedunculata, Q. sessiliflora,* and *Q. pubescens* (incl. *Q. lanuginosa*). Figs. 113-117, 125-126.

RANGE.—England: Perthshire, Undercliff (acc. Mayr-Fitch 1876). Cannwood (acc. Bignell 1879). Wolmer Forest (acc. Swanton 1912). Birchwood (acc. Marshall 1867). Keswick (E. S. Anderson in Kinsey coll.). Near London (acc. Smith 1867). Southsea (Moncreaff acc. Newman 1868). Kew (acc. Rolfe 1881). Worcestershire (acc. Fletcher 1880). Sedbury Park in Gloucestershire and Nottingham.

Sweden (acc. Linnaeus, Fauna suecica: 947).

Denmark: Almindingen and Hammershus in Bornholm (acc. Bayer 1909). Bromme, Stiznaes in Sjelland, Vilhelmsborg, Basnaes, Korsör, Fulrendal, Strödam in Sjelland, Bildso, Skelskör, Marsellsborg, Moesgaard, and Nyborg (Hoffmeyer in Kinsey coll.).

Holland (acc. Beyerinck 1883).

Belgium (Van Segvelt acc. Darboux and Houard 1907).

France: La Chapelle St. Quentin in Seine-Inf. (Noury in Kinsey coll.). Lorraine (acc. Liebel 1892). Nord (acc. Fockeu 1889). Bézu in Eure (Cornu acc. Houard 1922). Alençon (acc. Houard 1915). Paris (acc. Houard 1912). Bellevue (acc. Giard 1901). Montargis (Lesne acc. Houard 1914). Perray in Maine-et-Loire (Joubin acc. Houard 1914). Petites Dalles in Seine-Inf. (acc. Kieffer 1899). Arques-la-Bataille in Seine-Inf. (Bouvier acc. Houard 1914). Roissard in Isère, Monestier-de-Clermont in Isère, and Sinard in Isère (acc. Cotte 1910). Mezin (Ducomet acc. Houard 1905). Allauch, Gémenos-Saint-Pons in Bouches-de-Rhône, Luynes-Valabre in Bouches-de-Rhône, Pertuis, la Tour-d'Aigues in Vaucluse, Peypin-d'Aigues in Vaucluse, Saint-Martin-de-la-Brasque in Vaucluse, la Motte-d'Aigues in Vaucluse, le Logis-Neuf in Vaucluse, Apt, Dourbes in Basses-Alpes, La Môle in Var, Cogolin, Grimaud, and La Garde-Freinet in Var (acc. Cotte 1912). Bourg-le-Comte (acc. Larue 1928).

Switzerland: Bern (acc. Uhlmann 1880). Lake Geneva (Forel acc. Mayr 1872). Near St. Gallen (acc. Vogler 1906). Goldachtobel (Müller acc. Vogler 1906). Laufenburg (acc. Blösch 1903).

Germany: Solingen (P. Eigen in Kinsey coll.). Schleswig (acc. Adler 1881). Nassau (acc. Schenck 1865). Near Segeberg and Niendorf (acc. Jaap 1927). Halle (Schlechtendal acc. Mayr 1872). Erlangen

(Rosenhauer in Kinsey coll.). Freiburg i. B. (acc. Rössig 1904). Bavaria (acc. Ross 1916). Chemnitz (Hedicke det. in Kinsey coll.). Hohenprieszsnitz in Saxony and near Wittenberg in Saxony (acc. Weidel 1911). Blankenburg (Forsius det. in Kinsey coll.). Breslau (Dittrich acc. Hieronymus 1890). Dresden (in Kinsey coll.). Gera (acc. Dieroff 1911). Ransern, Deutsch-Lissa, Nippern, Muckerau, Oderwilxen, Sackerau, Domatschine, Sibyllenort, Freiburger Stadtforst, Fürstenstein, Zobten, Schmiedeberg, Buchwald, Fischback, Hirschberg, Görlitz, Weih-Mühle near Grünberg, Jauernicker Berge, Moys, Langenölsener Berge, Geiersberg, Költschenberg, near Strehlen, and Blankenburg in Harz (all acc. Hieronymus 1890). Neusalz, Breslau, Jauer, Löwenberg, Langenbielau, Grünberg, Sagan, and Niesky (acc. Dittrich and Schmidt 1909). Pfronten-Dorf (acc. Ross 1922). Berlin (Magnus; also in Kinsey coll.). Near Mittenwalde (acc. Hedicke 1922). Clessin in Brandenburg (acc. Ross

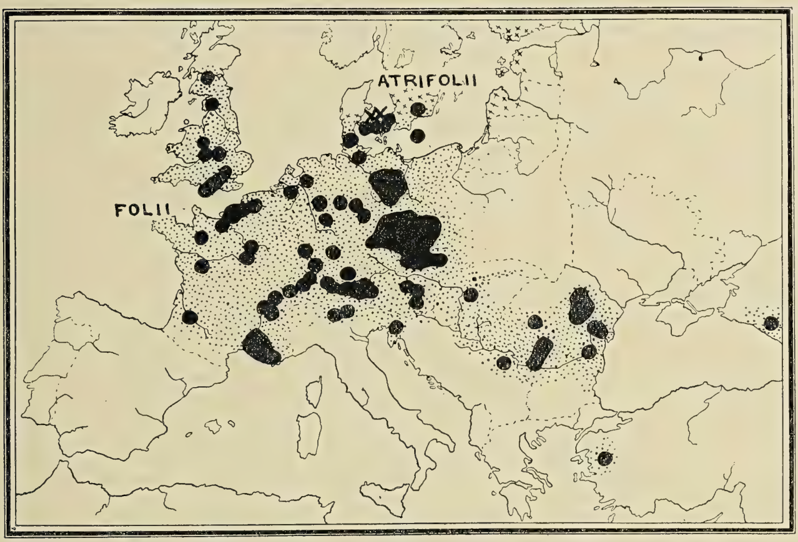


FIG. 15. CYNIPS FOLII VARIETIES ON QUERCUS ROBUR
Possible extensions of known ranges shown by shading.

1922). Grunewald, Teufelsee, Brisetal, Wildpark, and Zehlendorf (acc. Hedicke 1915). Bleicherode (P. Eigen coll., Forsius det. in Kinsey coll.). Würtemburg (in Kinsey coll.). Meckbach, Teufelskanzel in Werratal, Söhre, and Belgerkopf (acc. Schulz 1911).

Czecho-Slovakia: Elbogen (acc. Brehm 1906). Brno and Obřany near Brno (Baudys in Kinsey coll.). Nov. Bydzov (acc. Baudys 1923). Brandys nad Labem, near Prague, Touskov, Jicín, and Kralové Hradec (acc. Bayer 1910). Lanzhot, Slezsku, Trebíc, Bílovice, Námest n. Osl., Trest, Kral. Pole, Hluboká n. Vlt., Lysá n. Lab., Smidary, Nechanice, Libán, Rozdalovice, Kopidlno, Ml. Boleslav, Sychrov, Zbraslav, Robousy, Hornim Lochovem, Zeleznice, Litomérice (all acc. Baudys 1926). Nerato-

witz and Pardubice (acc. Baudys 1916). Also see Bayer, 1914, Moravské Hálky: 60, 73, 76.

Austria: Northern Tyrol (acc. Fortwaengler 1907). Bregenz (acc. Rössig 1904). Egerdach in Tyrol (acc. Dalla Torre 1892). Atzwang (Peyritsch acc. Dalla Torre 1892). Vienna (Mayr, incl. in Kinsey coll.). Rheinpreussen (Tischbein acc. Mayr 1874). Middle of Kainach Valley (acc. Hoffer 1890).

Italy: Triest (acc. Gräffe 1905). Gardasee (Pollini acc. Dalla Torre 1892). Trentino (acc. Cobelli 1905).

Spain (acc. Tavares 1928; doubtful determination).

Jugo-Slavia (Trotter acc. Darboux and Houard 1907).

Hungary: near Budapest (Sajo in Kinsey coll.).

Rumania: Hermannstadt (acc. Henrich 1916).

Caucasus (Radoszkowski acc. Kieffer 1901).

Asia Minor: Adabazar (Bouquet acc. Houard 1913: 106; also on *Q. sessiliflora,* Trotter acc. Houard 1922).

Apparently confined to more Central Europe, known from Rumania (or Asia Minor?) to southern France, England, and Sweden. Replaced in the Mediterranean area of Europe and Africa by the variety *flosculi* (and still others?), and replaced in more northern Europe by the variety *atrifolii.* Figure 15.

ORIGINAL DESCRIPTIONS: Of *folii:* Linnaeus, 1758, Syst. Nat. ed. 10, 1:553. Quercus folii. C. nigra, thorace lineato, pedibus griseis, femoribus subtus nigris. Fn. svec. 947. Rhed. ins. 157. Frisch ins. 2.t.3.f.5. Reaum. ins. 3.t.39.f.14-17. Blank. ins. t.16.f.A-H. Roes. ins. app. t.52, 53. f.10, 11. Leuwenh. nat. 217. Habitat in Gallis foliorum Quercus globosis pagina inferiore; avellanae magnitudine. Amoen. acad. 3. p. 324.

Translation: Cynips Quercus folii. A black *Cynips* with a striped thorax and gray legs in which the femora are black beneath. [References.] Living in rounded galls on the under surfaces of the leaves of the oak; these galls the size of a filbert.

Of *Diplolepis No. 1* (=*Diplolepis quercus* Fourcroy 1785): Geoffroy, 1762, Hist. Ins. 2: 309, pl. 15, fig. 2.

Diplolepis fuscus, gallae globosae glabrae & durae foliorum quercûs. Planch. 15, fig. 2. [References.]

Cet insecte est tout brun & assez luisant. Ses antennes sont de la longueur de son corps. L'animal est gros, court & ramassé comme ceux de ce genre. Ses aîles sont transparentes, plus longues du double que son corps, & elles ont à leur bord extérieur un point marginal brun. L'insecte les porte ordinairement à plat & croisées sur son corps.

C'est dans ces galles rondes, dures & lisses qui viennent sur le revers des feuilles du chêne, que naît cet insecte. Ces mêmes galles produisent un cinips, comme nous l'avons déja vû. Il s'agiroit de savoir si c'est le cinips ou le diplolepe quit est le véritable habitant de la galle; c'est ce qu'il n'est pas aisé de déterminer: peut-être le cinips, en déposant ses oeufs, donne lieu à la galle de se former, & que le diplolepe dépose ensuite son oeuf dans la galle commencante, ce qui fait

périr la larve du cinips: peut-être aussi ces deux insectes étant armés de semblables aiguillons, peuvent-ils l'un & l'autre déposer leurs oeufs sur les feuilles du chêne & occasionner des galles semblables.

Translation: A dark colored *Diplolepis* from a globular, naked, and hard gall on the leaves of the oak. [References.] This insect is entirely brown and rather shining. Its antennae are as long as its body. It is large, with a body that is compacted as with others of the genus. Its wings are transparent, more than twice the length of the body [corrected to "less than twice the length" in 1799 edit.], having a brown spot on each anterior margin. The wings are ordinarily carried flat, one on top of the other, on the insect's body.

The insect originates in galls that are rounded, hard, and shining and occurring on the under surfaces of the leaves of the oak. These same galls produce a *Cynips* [*i.e.* a parasite!] which we have already considered. It is still to be determined whether it is the *Cynips* or the *Diplolepis* that is the rightful inhabitant of the gall; and that is not easy to determine; for it may be that the *Cynips*, in laying its eggs, gives rise to the gall, and that the *Diplolepis* then lays its eggs in the developing gall and thus causes the death of the larva of the *Cynips;* or it may be that the two insects have similar ovipositors which allows either one to produce this sort of gall when it oviposits on the leaves of the oak.

Of *scutellaris.* Olivier, 1791, Enc. Méth. 6: 282. Diplolepis scutellaris.

Diplolepis niger, scutello rufescente, alis puncto nigro.

Il a environ deux lignes & demie de long. Les antennes & le corps sont légérement velus & d'un brun noir. L'abdomen est noir & luisant. L'écusson est rougeâtre. Les ailes sont un peu plus longues que l'abdomen; les nervures sont noires sur la partie extérieure, & forment, par leur réunion, une petite tache noire au milieu de l'aile.

La galle que produit cet insecte, vient sur le revers des feuilles du Chêne, & ressemble parfaitement au fruit de l'Arbousier: est rougeâtre, globuleuse, & entièrement couverte de petites tubérosités.

Il se trouve à Manosque, ou il a été observé par M. Danthoine.

Translation. A black *Diplolepis* with a reddish scutellum, each wing with a black spot. The insect is about 5 mm. long. The antennae and the body are finely pubescent and brownish black. The abdomen is shining black. The scutellum is reddish. The wings extend a little beyond the abdomen; the wing veins are dark toward the anterior margin, forming by their fusion a small, dark spot [areolet] in the middle of the wing. The gall which gives this insect occurs on the undersides of the leaves of the oak, closely resembling the fruit of the strawberry tree *(Arbutus unedo).* It is red, globose, and well covered with small tuberosities. It occurs at Manosque where it has been observed by D'Anthoine.

TYPES.—Not designated for either *folii, quercus,* or *scutellaris,* and probably not in existence. The Linnean material of *folii* possibly from Sweden, possibly from more Central Europe; the Geoffroy mate-

rial *(Diplolepis No. 1)* on which Fourcroy's *quercus* was based apparently from the neighborhood of Paris; the source of Olivier's material of *scutellaris* may also have been central France, or it may have been Manosque (the only locality mentioned in the publication) in Provence.

The present descriptions are based on the published descriptions cited in the bibliography, and on adults and galls which I have from localities in Denmark, Germany, Czecho-Slovakia, Hungary, Austria, France, and England, determined by G. Mayr, Forsius, P. Eigen, Noury, Sajo, Hoffmeyer, Hedicke, and L. H. Weld, as detailed in the above distribution data.

INQUILINES.—*Synergus albipes* Hartig (acc. Blösch 1903).

S. nervosus Hartig (acc. Hartig 1840). Emerges from February to April in the following spring (acc. Dalla Torre and Kieffer 1910).

S. pallicornis Hartig (acc. Hartig 1840). Emerges in May of the following spring; lives inside the larval cell (acc. Mayr 1872).

S. physoceras Hartig? (acc. Dalla Torre and Kieffer 1910).

S. tscheki Mayr (acc. Mayr 1872). Emerges in April of the following spring.

S. varius Hartig (acc. Hoffmeyer 1925).

S. vulgaris Hartig (acc. Hartig 1840). Emerges from March to May in the following spring (acc. Dalla Torre and Kieffer 1910).

Saphonecrus connatus (Hartig) (acc. Mayr 1872). Emerges in April and May of the following spring (acc. Dalla Torre and Kieffer 1910).

Steganoptycha corticana H. (acc. Riedel 1910). Lepidopteron.

[Reinhard, 1865, Berliner Ent. Zeit. 9:2, is in error in saying Hartig bred *Synergus nigripes* and *S. flavicornis* from *folii*.]

PARASITES.—*Callimome antennatus* Walker (acc. Mayr-Fitch 1866). Emerges March to June of the following spring; sometimes hyperparasitic on the inquilines.

Camptoptera dryophantae (acc. Kieffer 1902).

Cecidostiba truncata Thomson (Thomson 1878 acc. Dalla Torre 1898).

Decatoma biguttata (Swederus) (acc. Marshall, 1867). Emerges in May of the following spring, earlier indoors (acc. Mayr-Fitch 1876).

D. strigifrons Thomson (Kieffer 1886 acc. Kieffer 1899).

Eupelmus urozonus Dalman (acc. Ruschka 1920).

E. vesicularis (Retzius) (acc. Ruschka 1920).

Eutelus dilectus Walker (acc. Fahringer 1921).

Eurytoma appendigaster (Swederus) (Möller 1882 acc. Dalla Torre 1898).

E. aterrima (Schrank) (Rondani acc. Dalla Torre 1898).

E. nodularis Boheman (acc. Mayr-Fitch 1876).

E. rosae Nees (acc. Ratzeburg 1848). Emerges in May and June of the following year (acc. Mayr 1878).

Habrocytus saxesenii Ratzeburg (acc. Riedel 1910).

Megastigmus dorsalis (Fabricius) (acc. Mayr-Fitch 1876).

Mesopolobus fasciiventris Westwood (= *Pteromalus fasciculatus* Förster) (acc. Ratzeburg 1848). Emerges in November of the same year (acc. Mayr 1903).

Ormyrus punctiger Westwood (acc. Mayr 1904).

O. tubulosus Fonscolombe (acc. Wachtl 1876). Emerges in June of the following year (acc. Mayr 1904). Emerges in that March (acc. Wachtl 1876).

Porizon claviventris Giraud (acc. Mayr-Fitch 1876).

Pteromalus jucundus Förster (acc. Ratzeburg 1848).

Syntomaspis sapphyrina (Boheman) (= *S. caudata* (Nees)) (Brischke 1882 acc. Kieffer 1899).

Torymus abdominalis Boheman (incl. *T. cingulatus* (Nees?)) (acc. Mayr 1874). Emerges in August of the same year (acc. Wachtl 1876).

T. auratus (Fourcroy) (acc. Kieffer 1899).

T. azureus Boheman (= *T. chalybaeus* Ratzeburg) (acc. Blösch 1903).

T. elegans Boheman (acc. Mayr-Fitch 1876).

T. flavipes (Walker) (acc. Dalla Torre 1898).

T. incertus Förster (acc. Ratzeburg 1848).

T. nigricornis Boheman (= *T. regius* Nees and *Callimome inconstans* Walker). Emerges in October of the same year into the summer of the following year (acc. Mayr 1874). Emerges in March (acc. Wachtl 1876).

There are several errors in previously published lists of parasites, due to confusion caused by Mayr's earlier use of the name *folii* for what is now known as *pubescentis (q.v.)*.

This is the well-known, Central European variety of *folii*, recorded from nearly every locality where Cynipidae have been collected in that area, and described as sometimes covering many of the leaves of certain trees. Kieffer recorded (1901:184) an average of six galls for each of seven leaves, and as many as sixteen galls on a single leaf; and Connold (1908) found as many as twelve galls per leaf in southern England. This has been called the "cherry gall" in England, and its size and abundance, and the bright red colors of the fresh gall have made it an object of some popular as well as widespread scientific interest.

The young galls of the agamic *folii* appear in early summer, as early as mid-June (acc. Schlechtendal 1870) or early July (acc. Adler 1881) in Germany. Galls collected in northern England on August 15 (1927, Anderson in Kinsey coll.) were still not mature. The galls are full-sized by the end of August in England (acc. Connold 1908), altho the larval insects are still very small at that time. Pupation may occur late in September (material from Moravia, Baudys in Kinsey

coll.), and mature adults may be found in the galls before that month is over (acc. Beyerinck 1883 and Kieffer 1901; also material from Moravia, Baudys in Kinsey coll.) or in October (acc. Adler 1881). As with nearly all the other species of the whole genus *Cynips,* the adults delay their emergence until late fall to early winter. The galls fall to the ground with the leaves late in October or early November, by which time the insects have chewed a passage thru to the epidermis which, however, is not broken until actual emergence occurs.

Emergence varies in different localities from October to March, tho the bulk of it occurs everywhere in the early winter. Schlechtendal (1870) records September and October emergence, and Cameron (1893) also records October emergence. Paszlavszky gives November as the time for Hungary (acc. Kieffer 1901). Kieffer (1901) gives late November and early December—no later—for Lorraine. Beyerinck (1883) also says November and early December for Holland. Adler (1881) records December and January with occasional emergence in February or even March, in Germany; and Mayr (1882) notes late winter emergence in Austria. There is a December 20 record for England (acc. The Ent. 4:77). The material which I have from Denmark (Hoffmeyer coll.) bears dates of October 20, November 11, 19, 23, December 5, 7, 10, 17, 21, 25, 27, and January 3, 8, 9, 11, and 14. Fitch (1876) recorded emergence from January 1 to 21 on the Isle of Wight. Bignell (1897) gives January 18 to 25 for his part of England.

Several observers have noted that this insect does not emerge from the galls until the temperature is lowered to near the freezing point, and emergence on dates after the middle of December are apparently for stray adults which were frozen before they effected their escape from the galls in early winter and which later emerged, as Adler (1881) noted, in the thaws that break into winter's régime. Beyerinck (1883:28) found that insects cut from galls before their normal emergence time would not lay eggs. The same author found that in a warm room emergence might be delayed until January, which is in accord with my observations on the fall generations of American *Cynips.* Paszlavszky (1883) instituted some exact determinations of the temperature effects on this insect's activities, with the following results:

At 8°C insects were inactive, apparently frozen

At 1°C insects were still lethargic
At 2-3°C insects moved a leg or antenna
At 5°C insects moved their bodies slowly
At 7°C insects moved more easily
At 10°C insects moved normally

Paszlavszky seemed to find that the insects from *Q. pedunculata* were more sensitive to low temperatures, becoming inactive and perishing sooner than those from *Q. sessiliflora.* This is a striking conclusion too important to accept without confirmation, for if it is true it suggests that the insects from these two, very closely related oaks are at least physiologically different and do not represent the same variety at all.

The records for the emergence of *folii* in the following spring or even later seem to me exceedingly doubtful. Fonscolombe (1832 acc. Cotte 1912) recorded an emergence for May 31, but Cotte confirms our common experience that the winter galls are empty, and I question whether the older author was making the same mistake that so many of the earlier workers clearly made in confusing gall makers and inquilines from the galls. Darboux and Houard's record (1901) for emergence delayed until the second winter finds no substantiation in precise data.

Over eighty years ago, before the alternation of cynipid generations was suspected, Hartig (1843) instituted the search for the missing male of *folii* by breeding between three and four thousand insects within a period of eight years. All of these insects, of course, proved to be females, but it was at that time that Hartig received an insect which Ratzeburg had taken to be the male of *folii.* Hartig showed this to be the male of an inquiline cynipid.

The agamic female contains 80 to 100 eggs (see fig. 91), each of which is nearly spherical and very large (acc. Kieffer 1901:15), the spherical body terminating in a short pedicel which is about 2¼ times as long as the rest of the egg. The female usually oviposits in the small, adventitious buds on the trunks of the older oak trees, or less often on the younger stems of the trees, as Adler first determined in Germany in 1877 and as Beyerinck later confirmed for Holland (1883). Adler's first work was done out-of-doors, and the results were confused by an infestation of the same buds by a totally different cynipid which led Adler at first to report (1877) *Tri-*

gonaspis crustalis as the alternate of *folii*. This error was corrected by further work which the same investigator undertook in 1878 and 1879 on potted plants indoors. Both Adler (1881) and Beyerinck (1883) described the ovipositor of the insect, which is fairly straight. The insect puts itself into a position to pierce the bud perpendicularly, laying but a single egg in each bud and usually requiring from ten minutes (acc. Beyerinck) to a half hour (acc. Adler) for the single oviposition. A droplet of a sticky secretion from the insect (acc. Beyerinck) fastens the egg inside the bud scales. It is not until the following March and April (acc. Beyerinck; end of April acc. Adler) that the first signs of gall formation are to be noted in these buds; but from 34 ovipositions Adler secured 11 galls which were well developed by the beginning of May. Adler's experiments were repeated in 1879, and left no doubt that the bisexual insect that alternates with *folii* is the bud gall inhabitant *taschenbergi*. Beyerinck confirmed these results in the autumns of 1880 and 1881 in Holland, adding many details concerning the insect biology, the gall histology, and the gall embryology.

Paszlavszky (acc. Kieffer 1901) noted the caraboid odor of the ovipositing females of the agamic *folii*. Perhaps these odors are similar to the pungent, acid odors emitted by so many of the agamic forms of American *Cynips*, especially the short-winged forms, when they are disturbed in any way at all.

The early development of the galls of the agamic *folii* has been studied by Beyerinck (1883) whose interesting diagrams are reproduced in the present paper (figs. 107-117). Beyerinck found that gall formation starts in the phloëm of the vascular bundles whose xylem is in contact with the egg. The new growth gradually develops within the vein, finally forming a canal which allows the young larva to pass from the xylem to the phloëm in which growth is proceeding. This is similar to the condition reported for other cynipid galls which originate from eggs that have been deposited deep in the vascular bundles, altho there is no formation of a canal for species in which the eggs are placed in the phloëm or cambium to begin with. Since the epidermis of the leaf does not directly contribute to the gall formation, the young gall ruptures the leaf epidermis to one side of the vein where the resistance is least. The larva has hatched before the rupture of the epi-

dermis, and now migrates by way of the canal into the developing gall. The empty egg is left in its original location in the xylem, the cavity in which it lies is gradually filled with a scar tissue (the development of which may be the means of forcing the larva to migrate thru the canal), the canal itself is closed at its base by the newly developing tissue, and the insect is thus enclosed in a larval cell in the heart of the gall.

Once having broken the leaf epidermis, the galls of *folii* remain attached to the leaf only by a very slender pedicel which, however, may contain a score of vascular bundles. The cytology of the mature gall has been described by Beyerinck (1883), by Hieronymus (1890), Fockeu (1889), and Weidel (1911), and its four zones of tissues are evident with a low power lens. These layers are: (1) An epidermis with few stomata, altho there are some stomata (contrary to the statements of some writers) on the basal two-thirds of the galls; (2) a parenchyma which has numerous, intercellular air spaces toward the outside and a much-branched, air-filled, and in the older gall a spongy parenchyma toward the center of the gall; (3) a protective zone of compacted tissue which, however, is not so well developed as it is in *Neuroterus;* and (4) a nutritive zone which is well developed, being formed of rounded cells that contain a granular protoplasm and droplets of oil. The nutritive zone lines the inside of the larval chamber and is absorbed, as with other Cynipidae, by the larval *folii* without the development of waste of any sort that can be detected within the larval cell. The collenchyma, which lies between the epidermal and parenchymal layers in most galls of *Cynips,* is absent in *folii.*

The mature galls of *folii* may weigh (acc. Trotter 1909) as much as 4.84 g. and average (acc. Kieffer 1901) between 2.0 and 3.0 g. This may be as much as twice the weight of the leaf which bears the gall, and Kieffer found that one leaf which bore 16 galls was burdened with 18 times its own weight. Most of the weight of these fresh galls is, of course, due to the water they contain, but because of the scarcity of stomata on the epidermis of the galls, they dry out very slowly. Trotter (1909) gives the following data on this point:

A fresh leaf weighing 0.70 g. dries in 9 days to 0.30 g.

A fresh gall weighing 4.84 g. requires 120 days to dry to 0.60 g.

This would indicate that water may constitute as much as 87.5 per cent of the weight of the fresh galls of *folii.*

The scarcity of stomata on these galls is also the explanation (as with many other cynipid productions) of their floating on water for some time before they sink.

Fresh galls are described as having a ripe apple odor which Connold (1908:18) believes to be more developed when the galls are on *Q. sessiliflora* than when they are on *Q. pedunculata.* The same author considers this odor an adaptation that, in some way which I cannot fathom, is designed to protect these galls.

F. Koch (1895, Archiv der Pharmacie, Berlin: 48-77, acc. Kieffer 1901: 195) finds that these galls develop sugar after maturing. Galls gathered in January have nearly twice as much sugar and a little less tannin than galls gathered in September, or, to quote in more detail:

Sugar in late Sept. = 21.49%; in Jan. = 51.81%
Tannin in late Sept. = 16.87%; in Jan. = 14.85%

The mature galls of *folii* may remain attached to the leaves on the ground for several months after the insects have emerged, even until the following April or May (acc. Connold 1908).

Cynips folii variety **folii**

bisexual form **taschenbergi** (Schlechtendal)

Figures 15, 77-78, 82, 89, 90, 107-113, 121, 127-128

Spathegaster Taschenbergi Schlechtendal 1870, Stettiner Ent. Zeit. 31: 391 (♀, ♂, ⊕). Mayr, 1871, Mitteleurop. Eichengallen: 70, pl. 7 fig. 96 (⊕). Rudow, 1875, Archiv. Naturg. Mecklenburg 29: 40, 61 (♀, ♂). Wachtl, 1876: 14, 20, 22, 24. Mayr-Fitch, 1878, The Ent. 11: 222, 225, fig. 96. Adler, 1881, Zeitschr. wiss. Zool. 35: 188, pl. 11 fig. 14a, pl. 12 fig. 5a (♀, ♂, ⊕, biol.). Adler-Lichtenstein, 1881, Génér. Altern.: 50, pl. 11 fig. 14a, pl. 3 fig. 5a (♀, ♂, ⊕, biol.). McLachlan, 1881, Ent. Month. Mag. 17: 259. Fockeu, 1889, Hist. Galles: 23. Eckstein, 1891, Pflanzengallen und Gallentiere: 59, 61, fig. 41, 53, 54, 55. Adler-Straton, 1894, Altern. Gener.: 63, pl. 2 fig. 14a, pl. 3 fig. 5a (♀, ♂, ⊕, biol.). Riley, 1895, Science n.s. 1: 463. Kieffer, 1903, André Hymén. Europ. 7 (2): 677. Henneguy, 1904, Les Insectes: 217, pl. 3 fig. 10, 11 (⊕, biol.). Connold, 1908, Brit. Oak Galls: 7, 116, 132, pl. 52 C. Cotte, 1912, Galles de Provence: 193. Borcea, 1912, Zoocecid. România: 81.

Trigonaspis crustalis err. det. Adler, 1877 (NOT Hartig 1840!), Deut. Ent. Zeitschr. 21: 240. Adler, 1877, Ent. Month. Mag. 14: 44. Lichtenstein, 1877, Bull. Soc. Ent. France 1877: 91. Katter, 1877, Ent. Nachr. 3: 153.

Spathegaster flosculi err. det. Mayr-Fitch, 1878, The Ent. 11: 225.

Spathegaster Taschenbergii Adler, 1881, Ent. Nachr. 7: 122.

Dryophanta Taschenbergi Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀, ♂). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: exc. 166, 169 (⊕). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 23. Liebel, 1892, Ent. Nachr. 18: 272. Cameron, 1893, Brit. Phytoph. Hymen. 4: 28, 122. Kieffer, 1901, André Hymén. Europe 7 (1): 108, 143, 159, 173-174, 623, 624, pl. 1 fig. 3, pl. 4 fig. 3-7, pl. 13 fig. 11-12 (♀, ♂, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 410. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Kieffer, 1903, André Hymén. Europe 7 (2): 677. Cobelli, 1905, Verh. zoo.-bot. Ges. Wien 55: 599. Vogler, 1906, St. Gallen Jahrb. Naturw. Ges. 1905: 335. Schmiedeknecht, 1907, Hymen. Mitteleuropas: 397, 398. Sajo, 1907, Prometheus 18: 438. Houard, 1908, Zoocécid. Europe 1: 238, fig. 352-353. Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 100. Riedel, 1910, Gallen und Gallwespen: 14, 22, 34, 81, 85, 87, pl. 4 fig. 9. Noury, 1911, Bull. Soc. Sci. nat. Rouen 1911: 141. Dieroff, 1911, Bericht ent. Vereins Lepid. 30: 27. Küster, 1911, Die Gallen der Pflanzen: 42, 161, 166, 317, fig. 6. Swanton, 1912, Brit. Plant Galls: 32, 38, 43, 168, 175, pl. 22 fig. 5. Trotter, 1923, Marcellia 19: 145.

Spathegaster taschenbergi Beyerinck, 1883, Ver. Akad. Amsterdam 22: 8, 32, 37, 94-122, pl. 3 fig. 37-44 (⊕, biol., histol.). Bayer, 1914, Moravské Hálky: 60, 76.

Dryophanta Taschenberg laps. Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: 168.

Dryophanta folii (sex. gen.) Cameron, 1893, Brit. Phytoph. Hymen. 4: 122, pl. 2 fig. 5 (♀, ♂, ⊕).

Dryophanta taschenbergii Dalla Torre, 1893, Cat. Hymen. 2: 54.

Dryophanta Taschenbergii Riedel, 1896, Gallen und Gallwespen: 21, 26, pl. 4 fig. 23. Schmidt, 1907, Zeit. Insektenbiol. 3: 348.

Dryophanta taschenbergi Oudemans, 1900, Nederland. Ins.: 749, fig. 402 IIb). Darboux and Houard, 1901, Zoocécid. Europe: 329, fig. 569. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 42. Ross, 1904, Gallenbild. der Pflanzen: 14, fig. 6, 35 (♀, ⊕). Gräffe, 1905, Boll. Soc. nat. Triest 23: 30. Hedicke, 1915, Zeit. Insektenbiol. 11: 23.

Diplolepis quercus-folii (sex. gen.) Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 346, 621, 742, 774?, 783, 788, fig. 57, 58 (♀, ♂, ⊕). Kieffer, 1914, Schröder Ins. Mitteleurop. 3 (3): 63. Houard, 1914, Marcellia 13: 25. Ross, 1916, Pflanzengallen Bayerns: 62, fig. 190 K. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 225, pl. 6 fig. 125, 126. Tavares, 1928, Broteria 25: 39, fig. 41, pl. 3 fig. 13-15.

Diplolepis taschenbergi Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3): 20, 23, 31, 42, 63, 70, fig. 36, pl. 3 fig. 11.

Diplolepis quercus folii Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66: 101.

Cynips folii form *taschenbergi* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

FEMALE AND MALE.—Said to differ in no respect from *C. folii flosculi* form *flosculi*. Differing from *C. longiventris longiventris* form *substituta* in having the legs including the femora a brighter, clearer yellow; differing from *C. divisa divisa* form *verrucosa* in having the mesonotum and mesopleura entirely smooth and shining (figs. 77, 78, 82, 89, 90, 92, 99, 113).

GALL.—Very similar to that of *C. folii flosculi* form *flosculi* and *C. longiventris similis;* bearing shorter hairs (which, however, form a solid, puberulent covering for the gall), being at first red and then rich violet-purple and finally blackened in color; on the young stems, or (more often) on the large stems or the main trunk, on *Quercus pedunculata* and *Q. sessiliflora;* probably also on *Q. pubescens*. Figures 107-112, 121, 127-128.

RANGE.—Probably the same as that of the agamic form of the variety *folii (q.v.)*, which ranges thruout more Central Europe (fig. 15). The bisexual form *taschenbergi* is definitely known from the following localities:

England: Sedbury Park in Gloucestershire (Ormerod acc. Mayr-Fitch 1878). Southern part (acc. Connold 1908). Nottingham (acc. Mayr-Fitch 1878).

Holland: (acc. Beyerinck 1883).

France: Normandy (acc. Noury 1911). Bitsch (Kieffer acc. Houard 1914).

Germany: Schleswig (acc. Adler 1881). Steglitz (acc. Hedicke 1915). Halle (Taschenberg acc. Schlechtendal 1870). Gera (acc. Dieroff 1911). Bavaria (acc. Ross 1916). Grünberg in Silesia (acc. Dittrich and Schmidt 1909). Wachberg near Dresden (acc. Riedel 1896). Tharandt (Baer acc. Riedel 1910). Zwickau (Schlechtendal acc. Riedel 1910). Solingen (P. Eigen in Kinsey coll.). Berlin (in Kinsey coll.).

Czecho-Slovakia: Jicín (acc. Baudys 1926).

Italy: Triest? (acc. Gräffe 1905).

Denmark: Basnaes (Hoffmeyer in Kinsey coll.). Korsör (Hoffmeyer in Kinsey coll.).

Rumania: Hermannstadt (acc. Henrich 1916).

ORIGINAL DESCRIPTION.—Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 391. SPATHEGASTER TASCHENBERGI, n. sp.

Niger; mesothoracis dorso nitidissime laevi; antennis ♂ 15 ♀ 14 articulatis, fusco-nigris, basi earum, mandibulis apice, abdominis petiolo basique segmenti primi extrema obscuris; squamulis pedibusque ferrugineis; coxis basi unguiculisque nigris. Alis hyalinis, neuris obscuris. Abdomine ♂ breviter petiolato, ♀ subsessili.

Longitudine corporis 2-2,5 Millimeter.

Die Wespe ist schwarz; der Kopf matt gerunzelt, der Scheitel stärker als das Gesicht, letzteres, sowie die Wangen sehr schwach greis behaart und mit einzelnen tieferen Grübchen versehen, denen die Haare entspringen, die Spitze der Mandibeln ist dunkel gefärbt. Die braunschwarzen Fühler des ♂ sind 15gliedrig, das zweite Glied graubraun, dunkel, bei dem ♀ sind dieselben 14gliedrig, und hier ist das erste, mit Ausnahme der braunschwarzen Basis, das zweite und das dritte, mehr oder weniger graubraun. Der Mittelrücken ist beim ♀ durchaus glatt und glänzend, während es beim ♂ zuweilen nach vorn äusserst schwach punktirt erscheint, zuweilen auch auf der Scheibe fein gerunzelt. Die beiden Längsfurchen sind nach hinten stark zusammenlaufend. Das Schildchen ist länger, als breit, an der Basis eingesattelt, wodurch der Vorderrand etwas aufgeschlagen erscheint, beim ♀ auf der Scheibe etwas schwächer gerunzelt als beim ♂. Die Beine sind rostgelb, die Basis der Schenkel sowie die Klauen schwarz, die Schenkelringe, ein Wisch an der unteren Seite der Schenkel, und die Spitze der hinteren Schienen etwas schwärzlich. Die glashellen Flügel haben dunkle Nerven. Der Hinterleib des ♂ ist klein, dreieckig und kurz gestielt, der des Weibchens fast sitzend, der Stiel und die äusserste Basis der ersten Hinterleibssegmentes sind graubraun. Die Länge der Körpers beträgt 2-2½ Millimeter.

Die Galle. Anfangs Mai findet sich diese schöne Galle, den Knospen an alten Eichenstämmen entspringend, seltener an jungen vorjährigen Zweigen, theils einzeln, theils zu mehreren zusammengedrängt. Sie haben eine mehr oder weniger eiförmige Gestalt, sind saftig, doch von einer gewissen Festigkeit. Die Oberfläche ist mit einer dichten sammtartigen Behaarung bekleidet, welche, in der Jugend lebhaft roth, zur Zeit der Reife dunkelviolett gefärbt ist, unter dem Mikroskop erscheint die Oberfläche mit warzenartigen Erhöhungen bedeckt, deren jede mit einem graden oder schwachgebogenen dicken Haar versehen ist. Die Haare sind farblos und nur im Innern mit violettem Farbstoff erfüllt. Die Gallen erreichen eine Grösse von 3½ Millim. Ihr Waschsthum ist sehr schnell. Anfang Mai erscheinen sie und noch vor der Mitte desselben Monats kommen die Wespen zum Vorschein.

Translation. Spathegaster Taschenbergi, new species. Black, with the mesonotum smooth and very shining; the antennae brownish-black, with 15 segments in the male and 14 in the female; the bases of the antennae, the tips of the mandibles, the petiole of the abdomen, and the very base of the next segment clouded; the tegula and the legs rufous; the bases of the coxae and the claws black; the wings hyaline ,the veins clouded; the abdomen of the male short-petiolate, that of the female nearly sessile. Length 2.0 to 2.5 mm.

The wasp is black, its head finely roughened, the vertex more so than the face, the face as well as the cheeks set with a thin gray pubescence and with scattered, rather deep punctations from which the hairs arise; the tips of the mandibles clouded. The brownish black antennae of the male are 15-segmented with the second segment light brown, clouded; the antennae of the female are 14-segmented, in this case hav-

ing the first segment (with the exception of the brownish black base), the second, and the third segments more or less light brown. The mesonotum of the female is entirely smooth and shining, while that of the male appears at times feebly punctate at the very anterior end, or at times finely roughened on the disk. The two parapsidal grooves are strongly convergent posteriorly. The scutellum is longer than wide, bound at the base so the anterior edge appears somewhat bordered, the disk in the female being more feebly rugose than in the male. The legs red-rufous, the bases of the coxae, as well as the claws black, the trochanters, a small spot on the under side of the femora, and the tips of the hind tibiae rather blackish. The hyaline wings have clouded veins. The abdomen of the male is small, triangulate, and short-petiolate, that of the female almost sessile; the petiole and the very base of the first abdominal segment are light brown; the length is 2.0 to 2.5 mm.

Early in May one may find these pretty galls originating from buds on old trunks of the oak or more rarely on the younger stems of the previous year's growth, sometimes singly, sometimes in large clusters. They are more or less egg-shaped and are succulent, but with a certain hardness. The epidermis is thickly covered with velvety hairs which are strikingly red when young, becoming dark violet when mature; the epidermis under a microscope appears covered with warty papillae every one of which supports a straight or slightly curled hair. The hairs are colorless and have the violet coloring matter only inside. The galls attain a size of 3.5 mm. Their development is very rapid. They appear early in May and yet even before the middle of that month the wasp may emerge.

TYPES.—4 insects (2 badly damaged) in the Vienna Museum (acc. F. Maidl in litt.). From Germany, probably from Halle.

The present descriptions are based on the published descriptions cited in the bibliography and on galls which I have from Berlin, insects from Solingen (P. Eigen coll.), and a fine series of 75 insects which I have from Denmark (Hoffmeyer coll.).

INQUILINES. — *Synergus gallae-pomiformis* (Fonscolombe). Emerges in June of the same year (acc. Dalla Torre and Kieffer 1910).

S. thaumacerus (Dalman). Emerges June 1 (acc. Wachtl 1876).

PARASITES.—*Eutelus erichsonii* (Ratzeburg) *(=Platymesopus erichsoni)*. Emerges the same June (acc. Wachtl 1876).

E. tibialis (Westwood) (=*Platymesopus westwoodi* Ratzeburg). Emerges the same June (acc. Wachtl 1876).

Pteromalus sp. Emerges the same June (acc. Wachtl 1876).

Torymus sp. Emerges the same August (acc. Wachtl 1876).

This is the best known of the bisexual forms of *Cynips*. Even tho the gall is so small that it often escapes attention, the abundance of the agamic *folii* in Central Europe results in *taschenbergi* being well represented in the collections.

Adler found the first gall formation at the end of April in Germany, when the tips of the buds became dark blue and soon showed the form of the purple, velvety galls. Adult insects appear within a couple of weeks after the galls are mature, being recorded as emerging from May 1 to June 1 (acc. Wachtl 1876), on May 26 and early June (acc. Adler 1881) in Germany, at about the same time in Holland (acc. Beyerinck 1883), and on May 25, 29, 30, 31, and June 2, 3, 4, 6, 7, 9, and 11 in Denmark (Hoffmeyer in Kinsey coll.).

It was Adler who first observed this insect oviposit in the main veins of the not fully mature leaves of the oak—leaves which were still growing actively enough to be capable of developing new galls. Adler believed that the insects, examining the leaves with their antennae, would not oviposit in places in which galls could not have been produced. The eggs are pushed into the center of the leaf veins, one egg into each wound, but usually a total of a half dozen or more to each leaf. About a month after oviposition had been observed in 1878, Adler obtained eight *folii* galls from the pricked veins, establishing by these experiments the relation of *taschenbergi* to *folii,* as he later connected *folii* and *taschenbergi.* Beyerinck's results (1883) added detailed confirmation to Adler's work at this point.

Beyerinck (1883) is further to be credited for careful observations on the early development of the young gall of *taschenbergi.* Gall formation begins when the larva is formed but still within the egg. The first indication of the gall is an enlargement of the plant cells in the vicinity of the egg. These developing tissues, arrested where they come in contact with the egg, grow about the egg and completely envelop it. A larval cell is thus formed by the time the insect begins to show its larval segmentation but before it has emerged from the egg. The gall structure involves not only the growing tip of the young twig but the very young leaves as well, a fact that apparently explains the tiny, leaf-like irregularities that may sometimes be observed on the mature galls of *taschenbergi.* Beyerinck found one double gall which may have come from two eggs deposited in a single bud of the oak.

Liodora sulcata Förster (1869, Verh. Ges. Wien 19: 335), the insect on which Förster based his genus *Liodora,* is con-

sidered by Kieffer (1901: 620) a synonym of our present insect. Förster's original description is obviously inconsistent and it is not enough, it seems to me, for the certain recognition of synonomy from the publication alone. Förster's material came from France (Aix-la-Chapelle), Switzerland, and Sweden, but no one, as far as I can find, has recognized the insect in additional material. This, admittedly, seems evidence that Förster had some common insect which is now passing under another name, and Kieffer may have been correct in considering it a synonym of *taschenbergi;* but since *sulcata* (1869) would then have precedence over *taschenbergi* (1870), and since the status of the generic name *Liodora* is further dependent on this decision—which cannot be substantiated by authentic specimens—I prefer to withhold judgment on the point and have relegated *Liodora sulcata* to the list of excluded species at the end of the present paper.

Ormerod (1877, The Ent. 10: 43) recorded this gall as occurring on *Q. cerris* and *Q. cerris Lucombeana* in England. Fitch, on the same page in the same publication, questioned the determination of the cynipid. Houard (1908, Zoocécid. Europe 1: 330, 341) accepts Ormerod's original data, apparently overlooking the fact that Ormerod himself (1878, The Ent. 11: 201-204) soon decided that the galls he had collected were those of *Andricus circulans* instead of *taschenbergi.* There is, then, no basis for *Q. cerris* or its varieties as host of our *Cynips.*

Cynips folii variety **flosculi**

agamic form **pubescentis** (Mayr)

Figures 16, 95, 136, 137

——[no name] Malpighi, 1686, De Gallis: 20 line 38, fig. 17, and line 10, fig. 18 [acc. Massalongo, 1898, Malpighia 11:17].

Cynipidem Quercus folii Spinola, 1806, Ins. Ligur. 1:158. Mantero, 1906, Ann. Mus. Nat. Genova (3) 2:446.

Septima Especie Ramirez, 1808, Agric. Artes Madrid 23: [acc. Trotter, 1921, Marcellia 17:90].

Cynips Quercus folii err. det. Ratzeburg, 1844, Ichneum. Forstins. 1: 178. Ratzeburg, 1848, Ichneum. Forstins. 2:217. Ratzeburg, 1852, Ichneum. Forstins. 3: 35, 71, 91, 223, 254.

Cynips folii err. det. Schenck, 1865, Jahrb. Ver. Nassau 17-18: 179 (♀, ⊕). Karsch, 1883, Die Insektenwelt: 213. Dalla Torre, 1898, Cat. Hymen. 4:35, 259.

Dryophanta folii err. syn. Mayr, 1871, Mitteleurop. Eichengallen: 36, 37, pl. 5 fig. 49 (⊕). Err. syn. Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22:689, 710. Mayr, 1874, Verh. zoo.-bot. Ges. Wien 24:60, 80, 91, 97, 98. Mayr-Fitch, 1876, The Ent. 9:122, 123, fig. 49. Fitch, 1877, The Ent. 10:27. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28:318, 331. Dalla Torre, 1898, Cat. Hymen. 5:297, 310, 314, 342. Houard, 1908, Zoocécid. Europe 1:318?

Dryophanta pubescentis Mayr, 1881, Gen. gallenbew. Cynip.: 36 (no description). Mayr, 1882, Europ. gallenbew. Cynip.: 36 (♀?). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890:33. Massalongo, 1892, Atti Congresso bot. internaz. 1892: 31. Dalla Torre, 1893, Cat. Hymen. 2:54. Massalongo, 1893, Galle Flora Italica: 195. Riedel, 1896, Gallen und Gallwespen: 43 (♀). Massalongo, 1898, Malpighia 11:17. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 5, 6, 8. Kieffer, 1901, André Hymén. Europe 7 (1): 100, 123, 176, 635, pl. 19 fig. 9, 9a, pl. 21 fig. 16, 16a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 446. Darboux and Houard, 1901, Zoocécid. Europe: 308, 341, 354. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 40, 42, 43. Tavares, 1902, Rev. Sci. Nat. S. Fiel 1: 115 (in part?). Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Kieffer, 1903, André Hymén. Europe 7 (2): 679. Mayr, 1903, Verh. zoo.-bot. Ges. Wien 53:391, 396, 397. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54:574, 579. Gräffe, 1905, Boll. Soc. nat. Triest 23:31. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55:538, 546. Mantero, 1906, Ann. Mus. Nat. Genova (3) 2:450. Mantero, 1906, Ann. Mus. Nat. Genova (3) 4:72. Darboux and Houard, 1907, Galles de Cynipides: 237, pl. 21 fig. 1. Houard, 1908, Zoocécid. Europe 1: 254, 272, 278, 312, 322, 350. Brandza, 1914, Zoocecid. Romania: 1. Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70:238, 289. Trotter, 1923, Marcellia 19:144.

Dryophanta pubesescentis laps. Cameron, 1893, Brit. Phytoph. Hymen. 4:121.

Dryophanta scutellaris err. det. Stegagno, 1904, Marcellia 3:29. Err. det. Trotter and Cecconi, 1904, Marcellia 3:80.

Diplolepis quercus err. syn. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 344, 351, 624, 764, (777, 779, 780?), 786, 789, (792?), fig. 68, 69 (♀, ⊕). Cotte, 1912, Galles de Provence: XL I, 193. Houard, 1912, Marcellia 11:33, 110. Houard, 1913, Marcellia 12:106. Kieffer, 1914, Schröder Ins. Mitteleurop. 3 (3): 69, pl. 3 fig. 18. Houard, 1919, Marcellia 16:131. Houard, 1919, Marcellia 17: 11. Fahringer, 1921, Zeit. wiss. Insektenbiol. 16:231, 232. Fahringer, 1922, Zeit. wiss. Insektenbiol. 17:45. Houard, 1922, Marcellia 19: 79. Houard, 1922, Zoocécid. Afrique, etc. 1:119. Tavares, 1924, Broteria 21:10. Baudys, 1925, Publ. Inst. Phytopath. Brno C 39: 29. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 229, (243?). Tavares, 1928, Broteria 25:18, pl. 3 fig. 2, 2a, 5, 18, 19, 21 (in part only).

Diplolepis pubescentis Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3): 20.

Diplolepis quercus-folii err. det. Houard, 1922, Zoocécid. Afrique, etc. 1:130, 133?

[NOT *Cynips Quercus folii* Linnaeus, 1758, Syst. Nat. ed. 10, 1:553 (♀, ⊕).]

[NOT *Diplolepis quercus* Fourcroy, 1785, Ent. Paris: 391 (♀, ⊕) (acc. Dalla Torre and Kieffer, 1910, Das Tierreich 24:351).]

FEMALE.—Whole body with more bright rufous than in the other varieties, the mesonotum entirely punctate and hairy but less heavily so than in *folii;* the anterior parallel and lateral lines fairly prominent; the scutellum distinctly smoother anteriorly than posteriorly; the foveal groove largely smooth at bottom; the mesopleuron entirely punctate and rugose; the tip of the second abscissa of the radius usually triangulate or bent; the length 3.0 to 4.4 mm. (acc. Dalla Torre and Kieffer, 1910), averaging nearer 3.8 mm. Figure 95.

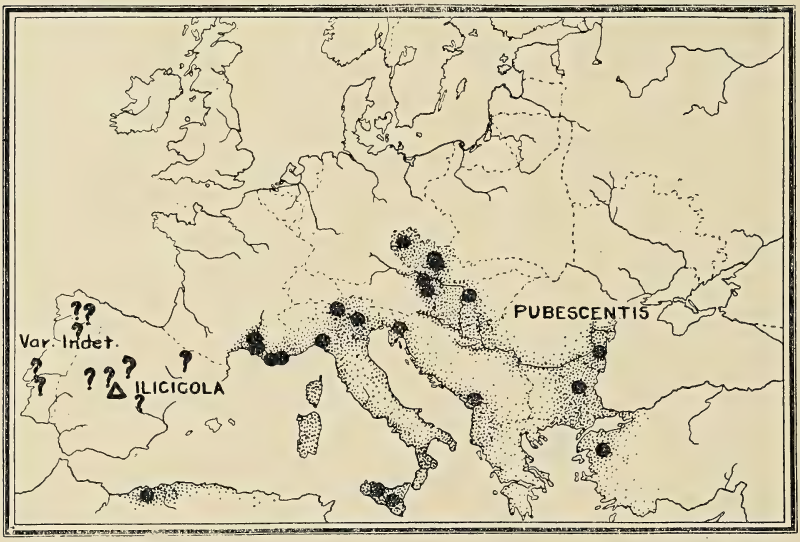


FIG. 16. MEDITERRANEAN VARIETIES OF CYNIPS FOLII
Possible extensions of known ranges shown by shading.

GALL.—Perhaps not as soft as the dried gall of *folii;* smaller, up to 10. mm. in diameter, quite regular in shape, rarely becoming distorted in drying, always smooth and naked, usually yellowish brown to light reddish brown in color, sometimes tinted with rose and irregularly marked with reddish spots, not becoming much darker when old or dried. On the leaves of (usually) *Quercus pubescens.* Also recorded from *Q. humilis prasina* (acc. Tavares 1902), *Q. lusitanica mirbecki* (acc. Houard 1922), *Q. lusitanica broteri* (acc. Tavares 1902), *Q. lusitanica faginea* (acc. Tavares 1902), *Q. pseudo-suber* (Kieffer acc. Houard 1908), *Q. toza* (acc. Tavares 1902), *Q. macranthera* (Rubsaamen acc. Houard 1908), and *Q. conferta* (Paszlavszky acc. Houard 1908), some of these records probably representing distinct varieties. Figures 136, 137.

RANGE.—Portugal: Several localities (acc. Tavares 1902 and 1928; probably distinct host varieties represented?).

Spain: Several localities (acc. Tavares 1928; probably distinct host varieties represented?).

France: Luynes-Valabre in Bouches-du-Rhône (Guillaud acc. Cotte 1912). Cogolin, Bormes, and Avignon (acc. Cotte 1912).

Italy: Palermo (Stefani acc. Houard 1912:33). Triest (acc. Gräffe 1905). Genoa (acc. Mantero 1906). Verona (acc. Massalongo 1892; also Trotter in Kinsey coll.). Tregnago (acc. Massalongo 1893). Lombardy (acc. Stegagno 1904).

Montenegro (Trotter acc. Darboux and Houard 1907).

Austria: (Mayr, incl. gall in Kinsey coll.). Vienna (Giraud acc. Schenck 1865).

Hungary: near Budapest (Sajo in Kinsey coll.).

Czecho-Slovakia: Bohemia (in Kinsey coll.). Pavlovské (Baudys in Kinsey coll.). Brno and other localities (acc. Bayer 1914).

Roumania (acc. Kieffer 1901).

Bulgaria (Trotter acc. Darboux and Houard 1907).

Asia Minor (Rübsaamen acc. Houard 1908; also H. Bouquet acc. Houard 1913: 106).

Africa: northern part (acc. Dalla Torre and Kieffer 1910).

Known thruout Mediterranean Europe and from Asia Minor and Africa; not definitely known north of the Pyrennes or the Alps except in Provence (southern France), Hungary, and Czecho-Slovakia. Replaced in more Central Europe by the variety *folii.* The records for Asia Minor need re-determination on the basis of bred insect specimens. Figure 16.

ORIGINAL DESCRIPTION.—Mayr, 1881, Gen. gallenbew. Cynip.: 36. Die Form: D. folii Schenck (Nass. Cynip., pag. 57) Mayr, welche ich *D. pubescentis* nenne und von Geoffroy (Hist. abrég. d.Ins. 1762, T. II, pag. 309, Pl. 15, Fig. 2 mit Ausschluss des Citates) besonders die Galle beschrieben und abgebildet wurde, dürfte wohl nur als Subspecies von D. folii L. zu betrachten sein.

Translation: Schenck's *D. folii* (cit.), which I am naming *D. pubescentis,* the gall of which, moreover, was described and figured by Geoffroy (cit.), is probably to be considered only a subspecies of *D. folii* Linnaeus.

Also Mayr, 1882, Europ. gallenbew. Cynip.: 36. Erzeugt kleinere, etwas plattgedrückt-kugelige harte, trockene Blattgallen an Q. pubescens und fliegt im Freien höchst wahrscheinlich zu Ende des Winters (bei Zimmerzucht schon, wie die vorige Art, zu Beginn des Winters) aus. Wahrscheinlich die agame Form von D. flosculi Gir.

Translation: Produces a small, rather comprest, spheroidal, hard, and dull-surfaced leaf gall on *Q. pubescens,* and emerges most likely at the end of the winter (at the beginning of the winter when bred indoors, just as with the previous species [*folii*]). Apparently the agamic form of *D. flosculi* Giraud.

It is not clear that either of the above can be considered as descriptions of the insect in a strict sense nomenclatorially. The first definite description of the insect seems to be in Riedel, 1896, Gallen und Gallwespen: 43. Kopf und Bruststück braunrot und schwarzbraun, Hinterleib schwarzbraun, ebenso die Fühler. Beine und Fühler zottig behaart. Länge: 3-4 mm. Agame Form zu Dryoph. flosculi (s. Nr. 31).

Translation: Head and thorax reddish brown and dark brown, the hind legs dark brown, and the antennae the same color. Legs and antennae hairy. Length 3 to 4 mm. The agamic form of *Dryophanta flosculi* (cf. No. 31).

TYPES.—5 females in the Vienna Museum (acc. F. Maidl in litt.). Mayr material from southern Austria and labelled "Types of Mitteleurop. Eicheng." also in the Museum of Comparative Zoölogy and in the Kinsey collection. The present re-descriptions are based on the American collections of the type material, and on insects and galls I have from Hungary, Bohemia, Moravia, and Italy, determined by G. Mayr, C. Sajo, P. Eigen, Ed. Baudys, and A. Trotter.

INQUILINES.—*Synergus pallicornis* Hartig (acc. Mayr-Fitch 1876). Emerges in April and May of the following year.

S. thaumacerus (Dahlman) (acc. Mantero 1906).

S. umbraculus (Olivier) (Magretti acc. Stegagno 1904).

PARASITES.—*Bracon aterrimus* Ratzeburg (acc. Ratzeburg 1852).

Cecidostiba collaris Thomson (acc. Mayr 1903).

Decatoma biguttata (Swederus). Emerges in May and June of the following year (acc. Mayr 1905).

D. variegata Walker (acc. Mayr 1905).

Eupelmus urozonus Dalman (acc. Ruschka 1920).

Eurytoma rosae Nees. Emerges from November of the same year to June of the following year (acc. Mayr 1878).

E. setigera Mayr. Emerges in the following January (acc. Mayr 1878).

Mesopolobus fasciiventris Westwood (acc. Mayr 1903). Emerges in November of the same year.

Olinx trilineatus Mayr (acc. Fahringer 1921).

Ormyrus punctiger Westwood (acc. Mayr 1904).

O. tubulosus (Fonscolombe) (acc. Kieffer 1901). Emerges in June of the following year (acc. Mayr 1904).

Orthostigma gallarum Ratzeburg (acc. Ratzeburg 1852).

Porizon claviventris Ratzeburg (acc. Ratzeburg 1852).

Pteromalus incrassatus Ratzeburg (acc. Mayr 1903). Emerges in September of the same year.

Syntomaspis lazulina Förster. Emerges in May and June of the following and also the next year (acc. Mayr 1874).

Torymus abdominalis Boheman (= *T. cyniphidum* Ratzeburg). Emerges in March of the following year (acc. Ratzeburg 1852 and Mayr 1874).

T. nigricornis Boheman (= *T. regius* Nees? and *T. longicaudis* Ratzeburg. Emerges from March to June of the following year (acc. Ratzeburg 1848 and Mayr 1874).

T. viridissimus Boheman (acc. Dalla Torre 1898?).

The life history of *pubescentis* differs little from that of typical *folii*, except as the more southern range of *pubescentis* may allow the earlier appearance of the agamic gall in the summer and the later emergence of the agamic adult in the winter. Cotte (1912) records pupae of the agamic form in Provence on November 8. Paszlavszky (acc. Kieffer 1901) says the adult emerges in Hungary in December, and Mayr (1882) records late winter emergence in Austria. I have bred adults from Moravian material on December 5 (1928). These dates are a month or so later than those for *folii* in more Central Europe, and parallel the later winter emergence of the more southern material of *Cynips* in North America. Mayr (1882) suggested that insects kept in a warm room would emerge in early winter, but this is to be doubted on the basis of our experience with other southern Cynipidae. Cotte's record (1912) of larvae in the agamic gall in February and emergence in June is at complete variance with the data for all other agamic *Cynips;* and the record must be questioned as applying to a true gall maker.

This variety is not well represented in the literature or the collections, tho that may be no indication of the actual abundance of the insect. Thruout most of its known range it is confined to *Quercus pubescens.* As far as I can determine, few insects have been bred from the galls on the numerous other oaks reported as hosts in southern Europe, Asia Minor, and Africa, and accurate determinations, which must await this insect material, will probably show there are distinct varieties on some of these hosts.

Kieffer (1903: 679) decided that his own *Dryophanta ilicis* (1896, Bull. Soc. Ent. France 1896:371) was a synonym of *Dryophanta pubescentis,* but the distinct host of *ilicis,* namely *Quercus Ilex,* makes me believe that careful comparisons of insect material from *Q. Ilex* and *Q. pubescens* may yet reveal that *ilicis* is a distinct, host variety. Pending the time when we can make such studies it will be better not to bury *ilicis* in the synonomy of *pubescentis.*

Both the geographic and host data for Beyerinck's record

of *pubescentis* on *Q. pedunculata* in Holland must surely apply to the variety *folii*. Kieffer (1901: 636) similarly questioned this record. I also question Hedicke's record (1915) for Mark Brandenburg in more northern Germany. Bagnall and Harrison (1918, Ent. Month. Mag. 54: 181, and Ent. Record 30: 157) say that this variety occurs in Durham, the Derwent Valley, Winlaton, Ovingham, Dipton Woods in Northumberland, and Corbridge, all of which are localities in northern England. They found both agamic and bisexual galls, describing the latter as "green or more or less red, furnished with long, curly pubescence, mostly of a bright red to purplish-red colour." This description fits *flosculi* so well that it invites further investigation, but I still cannot accept records which are nearly eight hundred miles outside of the proved range of this insect, and which seem to be based on galls alone. Insects from all such unusual material must be carefully compared with series of Mediterranean material before we may be certain of determinations of such closely related cynipids as *folii* and *flosculi*.

Mayr (1882) referred to *pubescentis* as (translating) "Apparently the agamic form of *D. flosculi* Giraud." As far as I know, this connection was based on the practical identity of *flosculi* with *taschenbergi* (the bisexual form of *folii*) and Mayr's recognition of the close relationship of *folii* and *pubescentis*. Unless experimental work ultimately disagrees, we may accept Mayr's conclusions.

Lacaze-Duthiers (1853: 273) has made histologic studies of the gall of *pubescentis* (acc. Kieffer 1901).

Cynips folii variety flosculi

bisexual form **flosculi** (Giraud)

Spathegaster flosculi Giraud, 1868, Bull. Soc. ent. France 1868:54 (♀, ⊕). Mayr, 1871, Mitteleurop. Eichen-gallen: 50, 69 (⊕). Mayr-Fitch, 1876, The Ent. 9:76. Bayer, 1914, Moravské Hálky :84.

Spathegaster giraudi Tschek, 1869, Verh. zoo.-bot. Ges. Wien 19:559 (♀, ♂, ⊕). Mayr, 1870, Mitteleurop. Eichen-gallen :32, pl. 4 fig. 41 (⊕).

Spathegaster Giraudi Mayr, 1870, Mitteleurop. Eichen-gallen: 32, 60, pl. 4 fig. 41 (⊕). Mayr-Fitch, 1876, The Ent. 9:65, fig. 41.

Dryophanta flosculi Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890:23. Cameron, 1893, Brit. Phytoph.

Hymen. 4:121. Dalla Torre, 1893, Cat. Hymen. 2:50. Riedel, 1896, Gallen und Gallwespen: 35. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 2. Kieffer, 1901, André Hymén. Europe 7 (1): 108, 625, pl. 16 fig. 12 (♀, ♂, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901:410. Darboux and Houard, 1901, Zoocécid. Europe: 329, fig. 568. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 41. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Kieffer, 1903, André Hymén. Europe 7 (2): 678. Mayr, 1903, Verh. zoo.-bot. Ges. Wien 53:392, 397. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55:546. Gräffe, 1905, Boll. Soc. nat. Triest 23:31. Darboux and Houard, 1907, Galles de Cynipides: 218, pl. 18 fig. 5 (⊕). Houard, 1908, Zoocécid. Europe 1:237, (275?), fig. 351. Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70:238, 304. Trotter, 1923, Marcellia 19:144.

Diplolepis quercus (sex. gen.) Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 351, 642, 742, fig. 67 (♀, ♂, ⊕). Houard, 1912, Marcellia 11: 33, 110. Houard, 1919, Marcellia 16: 139. Houard, 1919, Marcellia 17: 11. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 224. Tavares, 1928, Broteria 25:21, fig. 35.

Diplolepis flosculi Kieffer, 1914, Schröder Ins. Mitteleurop. 3 (3): 20, 42, pl. 2 fig. 13.

FEMALE AND MALE.—Apparently as described for the subgenus and species, said to differ in no respect from the bisexual insects of *C. folii folii* form *taschenbergi;* therefore differing from *C. longiventris* form *substituta* in having the legs including the femora a brighter, clearer yellow; differing from the bisexual *C. divisa* form *verrucosa* in having the entire mesonotum and mesopleuron smooth and shining.

GALL.—Very similar to that of *C. folii folii* form *taschenbergi* and *C. longiventris* form *similis;* described as bearing longer hairs which are yellowish and red in color; recorded only from buds on the young stems of *Quercus pubescens* (and *Q. Toza?*).

RANGE.—Probably that of the agamic form *pubescentis* (fig. 16), which occurs thruout the Mediterranean area of Europe, Asia Minor, and northern Africa. The bisexual form *flosculi* is known definitely from:

France: Vincennes (acc. Giraud 1868).
Italy: Palermo (Stefani acc. Houard 1912:33).
Austria: Vienna (Mayr acc. Tschek 1869).
Hungary (Paszlavszky acc. Kieffer 1901).
Czecho-Slovakia (acc. Bayer 1914).

ORIGINAL DESCRIPTIONS.—Of *flosculi:* Giraud, 1868, Bull. Soc. ent. France 1868:54.

4° Galle de *Spathegaster flosculi* Mihi.

Cette forme, que j'ai observée depuis longtemps en Autriche, est aussi inédite. Les échantillons que j'ai découverts à Vincennes sont perforés, presque secs, mais très-reconnaissables. Elle est plus précoce que l'espèce précédente et se montre dès les premiers signes du réveil de la

vegetation. L'insecte en sort pendant la seconde moitié d'avril. C'est sur les brindilles ou sur les rameaux bas et peu vigoureux du chêne qu'on trouve cette galle. Elle tient la place d'un petit bourgeon qui a disparu et dont il ne reste que quelques écailles à la base du nouveau produit. Sa forme est conique, sa hauteur de 4 à 5 millimètres, sa substance charnue, mais un peu moins tendre que celle de l'espèce précédente. Elle est richement parée de filaments très-fins, doux au toucher, d'une belle couleur rouge ou cramoisie, qui lui forment une sorte d'enveloppe veloutée.

L'insecte qui habite cette galle est plus robuste que la *Spathegaster tricolor* et très-distinct de cette espèce. J'en donnerai la description dans un travail spécial.

Translation. Gall of *Spathegaster flosculi* new species. This species, which I have observed for some time in Austria, is still undescribed. The material which I found at Vincennes showed emergence holes and was quite dry but still entirely recognizable. It appears earlier than *Spathegaster tricolor* Giraud, being visible with the first appearance of the new vegetation. The insect emerges during the second half of April. The gall occurs on the twigs or on the lower and less actively growing branches of the oak. It replaces a small bud of which nothing remains but a few bud scales at the base of the new growth. It is conical in form, 4 to 5 mm. high, fleshy, but not quite as soft as the gall of *tricolor*. It is densely set with very fine, soft hairs which are beautifully red or scarlet in color and which form a pubescent covering for the gall. The insect which inhabits this gall is more robust than *Spathegaster tricolor* and quite distinct from that species. I shall describe it in a special paper.

Of *giraudi:* Tschek, 1869, Verh. zoo.-bot. Ges. Wien 19: 559-560. Am 1. Mai d. J. fand ich auf niedrigem Gesträuch von *Quercus pubescens* eine kleine Galle, die sich bei näherer Untersuchung als neu herausstellte. Dieselbe sitzt seitlich an den Zweigen und schwachen Aesten, nie an deren Spitze, und ist offenbar eine Knospengalle; sie wird 2.75-4.5 mm. lang, ist im Umrisse eiförmig, von abstehenden Fasern dicht zottig, an ihrem Anheftungspunkte von kleinen braunen Schuppen umgeben, reif gelbgrün, in der Jugend meist roth gefärbt und besteht aus einer sehr dünnen, holzigen, wenig festen Schale, welche die Larvenkammer unmittelbar einschliesst. . . .

Spathegaster Giraudi n.

Niger; palpis mandibulisque saepe, femoribus, basi saltem anteriorum excepta, tibiisque testaceis; alarum anticarum cellula humerali nubecula fusca notata; mesothoracis dorso sulcato, polito, nitido; abdomine in ♂ petiolato, in ♀ subsessili; antennis in ♂ 15— in ♀, ut videtur, 14 articulatis. Long. 2-3 mm.

Der Kopf ist dicht punktirt, glanzlos; Mandibeln und Palpen meist schwärzlich, an manchen Stücken jedoch mehr oder weniger gelbbraun. Die Fühler des ♀ sind so lang wie der Körper, an der Basis oft etwas röthlich; die des ♂ länger, ihr 3. Glied hinten etwas ausgerandet. Der Mesothorax-Rücken mit tiefen Parapsiden-Furchen ist glatt und glän-

zend, nur an den äussersten Rändern mit einigen zerstreuten Punkten; Vorderbrustseiten punktirt, Mittelbrustseiten polirt mit einem fein runzligen glanzlosen Flecke unter den Vorderflügeln. Schildchen ziemlich grob runzlig, etwas glänzend. Hinterleib glänzend schwarz, der des ♀ gegen das Ende zusammengedrückt, etwas höher als lang, mit kaum merklichem Stielchen; der des ♂ klein, sehr zusammengedrückt, gestielt; Stielchen kaum so lang oder kürzer als die halbe Hinterhüfte. Flügel etwas getrübt, mit schwarzbraunen Nerven. In der Humeralzelle, dort wo der Mittelnerv kurz unterbrochen ist, ein sehr deutliches kleines Wölkchen von brauner Farbe; dies Merkmal ist constant und kann als für die Art charakteristisch angesehen werden. An den Beinen sind Hüften und Schenkelringe schwärzlich mit gelbbrauner Spitze, die Basis der Schenkel an den 2 ersten Fusspaaren schwarzbraun, die der Hinterschenkel meist etwas gebräunt; die Tarsen mit Ausnahme der Basis braun.

Translation: On the first of May of this year I found, on low bushes of *Quercus pubescens,* a small gall which proved upon further study to be undescribed. This occurs laterally but never terminally on the twigs and older stems, and it is apparently a bud gall. The gall is 2.75 to 4.5 mm. in length, being essentially egg-shaped, thickly set with a matted, upright pubescence, surrounded at the base with small, brown scales, and yellowish-green when mature, the young gall usually red and consisting of a very thin, woody but not very firm shell which directly encloses the larval cell. . . .

Spathegaster giraudi, new species. Black, the palps and often the mandibles, the femora except for their bases (at least of the anterior femora) and the tibiae brownish piceous; the subcostal [?] cell of the anterior wings marked with a clouded spot; the mesonotum with grooves, polished, and naked; the abdomen of the male petiolate, that of the female subsessile; the antennae of the male 15-segmented, that of the female, therefore, 14-segmented; length 2 to 3 mm.

The head is thickly punctate, dull; the mandibles and palps are usually dark, in many cases however more or less yellowish brown. The antennae of the female are as long as the body, often rather rufous basally, that of the male being longer, its third segment somewhat incised. The mesonotum with its deep parapsidal grooves is smooth and shining, having a scattered punctation only on its outer margin; the pronotum is laterally punctate, the mesopleura polished but the tegulae dull and finely rugose. The scutellum apparently quite rugose, rather shining. The abdomen shining black, that of the female compressed posteriorly, rather higher than long, with a scarcely noticeable petiole; that of the male small, much compressed, petiolate, the petiole scarcely as long or even shorter than half the length of the hind coxa. Wings slightly opaque, with dark brown veins. In the subcostal [?] cell, right where the subcosta is abruptly broken, there is a small and distinct, brownish spot which is constant and may serve as a diagnostic character for this species. As for the legs, the coxae and trochanters are black with golden brown tips, the bases of the femora of the two

first pairs of legs being dark brown, the hind femora usually rather brownish; the tarsi brown except at their bases.

TYPES.—Of *flosculi:* 6 stems of galls (and perhaps insects?) in the Giraud collection in the Museum d'Histoire Naturelle in Paris (acc. Houard 1919:11). This material determined by Giraud, tho probably not types in a strict sense. This material from France (acc. Darboux and Houard 1907), probably Vincennes, "on *Quercus Robur*" (acc. Houard 1919); but the original description also mentions Austrian material.

Of *giraudi:* 3 insects designated as types, and 5 specimens determined by Tschek, in the Vienna Museum (acc. F. Maidl in litt.). From Lower Austria, probably from near Vienna (acc. Kieffer 1901).

I have not seen these types. The present descriptions are therefore based on the published descriptions cited in the bibliography, on the excellent colored figure of the Giraud material published by Darboux and Houard (1907), and on an insect in the U.S. National Museum.

INQUILINE.—*Ceroptres arator* Hartig. Emerges the same summer (acc. Mayr-Fitch 1876).

PARASITES.—*Decatoma biguttata* (Swederus). Emerges in June of the same year (acc. Mayr 1905: 546).

Eupelmus vesicularis (Retzius) (acc. Ruschka 1920).

Platymesopus erichsoni Ratzeburg (acc. Mayr 1903). Emerges in June of the same year.

P. tibialis (Westwood) (Giraud 1877 acc. Kieffer 1899). Emerges in June of the same year.

Pteromalus incrassatus Ratzeburg. Emerges in June of the same year (acc. Mayr 1903).

Recorded specimens of this bisexual insect and of its small, bud-like galls are very few, and little is known of its biology. It will probably prove as widespread as its agamic form *pubescentis.* Meanwhile it serves as another instance of the meager data available on the Mediterranean cynipid fauna. Tschek (1869) found the adult insect emerging from May 2 to 11. Mayr (1882) was the first to suggest that this is the alternate generation of *pubescentis,* as I have noted in the account of *pubescentis.*

Mayr (1871: 69) stated that a Giraud-determined specimen of *flosculi* which was loaned him by Haimhoffen was the same as *Spathegaster giraudi* Tschek, and that *flosculi* has precedence by one month in publication. I re-publish this synonymy while pointing out that it is not impossible that Giraud had two different things from the two localities, Vincennes (near Paris) and Austria, mentioned in his original description. Since the agamic *pubescentis* is not definitely

proved to occur in France north of a narrow Mediterranean strip in Provence, it is more than likely that the Vincennes material represented the bisexual form of *folii*, altho the Austrian material might well have been, as Mayr determined, the same as Tschek's *giraudi* from Austria. Since none of these workers established holotypes, it seems impossible to settle this question on the basis of actual material, and I have accepted usage in the application of these names.

Cynips folii variety **ilicicola**, new name

agamic form

Figure 16

Dryophanta ilicis Kieffer, 1896, Bull. Soc. Ent. France 1896; 371 (♀, ⊕).

Dryophanta pubescentis err. syn. Kieffer, 1903, André Hymén. Europe 7 (2): 679. Err. syn. Houard, 1908, Zoocécid. Europe 1: 285.

Diplolepis quercus (agamic generation) Dalla Torre and Kieffer, 1910 (only in part), Das Tierreich 24: 351, 764, 778.

[NOT *Cynips quercus ilicis* Fabricius, 1798, Ent. Syst. Suppl.:213 (acc. Dalla Torre and Kieffer 1910: 391)].

FEMALE.—Not recognizable from typical *folii* on the basis of the published description (Kieffer 1896).

GALL.—Said to differ (acc. Kieffer 1896) from *pubescentis* only in its more irregular, spotted, and blunt-tuberculate surface. On *Quercus Ilex.*

RANGE.—Spain: Uclés (Pantel acc. Kieffer 1896). Figure 16.

ORIGINAL DESCRIPTION.—Kieffer, 1896, Bull. Soc. Ent. France 1896: 371. **Dryophanta ilicis** n.sp.—Voisin de *D. folii* L., dont elle diffère par le douzième article antennaire un peu moins long que gros, les ailes hyalines et l'oviducte proéminent.

Long. 3 mill.

La galle produite par cette espèce ne diffère de celle de *D. pubescentis* Mayr que par de petites verrues d'un brun sombre, entourées d'une tache brun clair, éparses sur la surface. Sur *Quercus Ilex* L. Je dois également cet insecte à l'obligeance du Révérend Père Pantel. Environs de Uclès.

Translation. Dryophanta ilicis new species. Related to *D. folii* L., from which it differs in having the twelfth antennal segment not quite as long as broad, in having hyaline wings, and in its protruding ovipositor. Length 3. mm. The gall produced by this species differs from that of *D. pubescentis* Mayr only in having small dull brown warts, surrounded by touches of clear brown, scattered over the surface. On *Quercus Ilex* L. I am indebted to Father Pantel for this insect. Found in the neighborhood of Uclés [in central Spain].

TYPES.—I have not been able to locate the Kieffer material. From Uclés, Spain; *Q. Ilex;* Pantel collector.

The present remarks on this insect are based on the original description.

Nothing seems to be known of this insect beyond the data accompanying Kieffer's original description of *ilicis* quoted in this paper. The insect characters mentioned in the description would not distinguish any variety of *folii*, and even the tuberculate surface of the gall would not of itself warrant the recognition of a distinct variety. Nevertheless I cannot accept Kieffer's (1903) later conclusion that *ilicis* is a synonym of *pubescentis*, for the hosts of the two, *Q. Ilex* and *Q. pubescens*, are as distinct as *Q. alba* and *Q. virginiana* in the eastern United States. From our American experience we should expect distinct, host-limited varieties from each of these oaks, and it seems unwise to bury this insect in synonomy until we have had an opportunity to compare good series of *Q. Ilex* insects from Central Spain with series of *Q. pubescens* insects from Austria.

In combining *ilicis* with the generic term *Cynips*, we find the name pre-occupied by Fabricius' *ilicis* (1798), and have consequently substituted the new name *ilicicola*.

Cynips folii variety **atrifolii**, new variety agamic form

Figures 15, 96

FEMALE.—Entire body including the legs and antennae piceous to jet black, rarely with a little rufo-piceous; the mesonotum smooth, shining, and quite naked except around the rim and along the parapsidal grooves, with a fine reticulation in places especially anteriorly between the anterior parallel lines; anterior parallel and lateral lines obscure; scutellum as rugose anteriorly as posteriorly; the foveal groove at least in part rugose; the mesopleuron with a smooth and naked spot or band above the center; the tip of the second abscissa of the radius not at all enlarged; length 2.1 to 2.7 mm., conspicuously smaller than *folii* or *pubescentis*. Figure 96.

GALL.—Apparently similar to the galls of the variety *folii*, the dried galls soft and spongy, probably nearer 10. mm. in diameter. On the leaves of the *Q. Robur* group of oaks.

RANGE.—Denmark: Bromme (Hoffmeyer; types). Korsör (Hoffmeyer in Kinsey coll.).

Probably restricted to a more northern area in Europe near the northern limits of oaks. Figure 15.

TYPES.—8 females, no galls. All the types temporarily in the Kinsey collection. Labelled Bromme, Denmark; gall September 29, 1927; E. B. Hoffmeyer collector.

This insect is known from only two localities in Denmark, but we have additional insects which are intermediate between *atrifolii* and *folii* from Strödam, Stiznaes, Moesgaard, and Basnaes in Denmark (all Hoffmeyer coll.). The probable occurrence of *atrifolii* in a pure population in more northern areas of Europe is indicated by the occurrence of such northern varieties in other species of *Cynips* in both Europe and America.

Cynips (Cynips) longiventris Hartig

agamic and bisexual forms

AGAMIC FEMALE.—The entire insect rich rufous and piceous (Central Europe) to entirely black (more northern Europe); the head slightly narrower than the more slender thorax (Central Europe) or practically no narrower (more northern Europe); the mesonotum largely punctate and hairy (more Central Europe) or largely naked (more northern Europe); the abdomen not more than half again as long as high, strongly produced dorsally, the tip of the second segment approaching the tip of the abdomen dorsally; the tip of the second abscissa of the radius not bent, usually triangulate but never large; the length 1.9 to 3.8 mm. in two varieties.

The Central European variety *longiventris (q.v.)* is nearly identical with *C. folii folii* and close to *C. divisa divisa* of the same region; the more northern variety *forsiusi (q.v.)* is very near *C. folii atrifolii* and *C. divisa atridivisa* of that region.

BISEXUAL FEMALE AND MALE.—As described for the genus and subgenus *(q.v.)*. Differing from the bisexual forms of other species of European *Cynips* in having the legs duller yellow with the femora more or less piceous and the mesonotum and mesopleura entirely smooth and shining.

AGAMIC GALL.—Of moderate size, spherical or somewhat ellipsoidal, solid, spongy, but harder than *folii*. Very regular in shape, only younger specimens becoming distorted in drying; up to 11. mm. in diameter; externally (usually) smooth and naked, occasionally with small, blunt projections on the gall; yellowish-green, then yellow or reddish in color, banded with irregular, concentric, rose-colored, purplish rose, darker brown, or purplish brown bands. The outer shell thicker, harder than in *folii*, distinguishable from the compact mass of radiating, much branched fibers that fill the gall; this mass not showing the lines of radiating fibers. The larval cell central, oval, averag-

ing 2.5 by 4.0 mm., with a distinct wall but inseparable from the compact filling of the gall. Attached to a leaf vein, on the undersides of leaves of *Quercus pedunculata* and *Q. sessiliflora.* Doubtfully identified on *Q. turneri* (Rolfe acc. Kieffer 1901).

BISEXUAL GALL.—Apparently very similar to that of the bisexual forms of *Cynips folii (q.v.).* Known only for the variety *longiventris* form *substituta,* where it is dull green in color, with a longer, gray pubescence, a more sharply pointed tip, and a smaller size which is up to 2.0 mm. in length. On the bark at the bases of older trees, less often on the two-year old stems; on *Q. pedunculata, Q. sessiliflora,* and *Q. pubescens.*

RANGE.—Known thruout Europe except in the Mediterranean area. The two described varieties, *longiventris* and *forsiusi,* are confined to more central Europe and northern Europe respectively.

The typical variety of *longiventris* is apparently common in Central Europe. The variety *forsiusi* is known only from southern Finland and Denmark. The species is strangely absent from the records for Mediterranean Europe. Our only indication of the occurrence of the insect there is Trotter and Cecconi's (1904) record for Italy without more definite locality, and a doubtful record (acc. Tavares 1928: 44) for Spain. There seems no available explanation to show why *longiventris* should differ from so many other species that have their Central European varieties matched by Mediterranean segregates.

Cynips longiventris and *Cynips folii* give striking data on the existence of physiologic species. The galls of the two are never to be confused, and yet the insects, in both agamic and bisexual generations, are so nearly alike that the European authors have usually accepted them as indistinguishable. Mayr (1882) thought he could distinguish the agamic females by the proportions of the twelfth antennal segments, some minor points of color, and the body length. These are the only distinctions made in the Kieffer (1901) and Dalla Torre and Kieffer (1910) monographs. Examination of good series of both *longiventris* and *folii* convince me that in antennal and color characters the insects vary more individually than they were supposed to differ specifically. The average length of *longiventris* is clearly under that of *folii,* but series again show many specimens of *folii* which are smaller than the larger specimens of *longiventris.* On the other hand, I offer the characters of the scutellum (see the description of the

varieties *folii* and *longiventris*) which seems to me distinctive in the several hundred insects I have examined. The bisexual females of *folii* and *longiventris* are to be distinguished on nothing more than the minor leg color characters noted by Adler, altho I find these characters apply definitely for the females (hardly for the males) which I have seen.

Central European *folii* and *longiventris,* then, are so completely physiologic species that from insects alone they would never have been separated. On the other hand, as if by deliberate contrast, the insect of the Finnish variety of *longiventris* is very different in structure from the Central European *longiventris* altho physiologically (in gall-producing capacities) it is not distinct.

The brilliantly banded galls of *longiventris* have probably invited many analogies in the minds of all of us, but it remained for Thomas (1897) to publish the suggestion that the galls actually "mimic" the banded shells of snails of the genus *Helix,* thus discouraging birds which are in search of insects. Such an extension of the natural selection hypothesis almost discourages serious attempts to evaluate the number of cases in which adaptation may have been a real factor in directing the course of evolution. Küster (1911: 400) similarly protests against Thomas' paper.

The known biologic data for *longiventris* apply almost entirely to the typical variety, under which the records are given in detail. Both the bisexual and agamic generations are known for that variety as the result of Adler's experimental work (1881).

Cynips longiventris variety **longiventris**

agamic form **longiventris** Hartig

Figures 17, 83, 97, 122, 130-132

——[no name] Malpighi, 1686, De Gallis: 21, line 19, fig. 19 [acc. Massalongo, 1898, Malpighia 11: 17].

Cynips longiventris Hartig, 1840, Germar Ent. Zeit. 2: 181, 188 (♀, ⊕). Hartig, 1843, Germar Ent. Zeit. 4: 406. Ratzeburg, 1848, Ichneum. Forstins. 2: 217. Ratzeburg, 1852, Ichneum. Forstins. 3: 254. Schenck, 1865, Jahrb. Ver. Nassau 17-18: 157, 175, 179, 223, 226, 250 (♀, ⊕). Reinhard, 1865, Berliner Ent. Zeit. 9: 6. Taschenberg, 1866, Hymen. Deutschl. : 144. Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 380. Müller, 1870, Ent. Month. Mag. 7: 108. Karsch,

1883, Die Insektenwelt: 213. Leunis, 1886, Thierkunde 2: 264. Schenkling, 1896, Ill. Wochenschr. Ent. 1: 217. Dalla Torre, 1898, Cat. Hymen. 5: 78. Blösch, 1903, Mitt. Schweiz Ent. Ges. 11: 48.

——[no name] Lacaze-Duthiers, 1853, Ann. Sci. nat., Bot. (3) 19: 303, pl. 16 fig. 10.

Dryophanta longiventris Mayr, 1871, Mitteleurop. Eichengallen: 36, pl. 5 fig. 50 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 689, 710. Mayr, 1874, Verh. zoo.-bot. Ges. Wien 24: 60, 80, 81, 91, 97, 98. Rudow, 1875, Arch. Naturg. Mecklenburg 29: 32, 56 (♀, ⊕). Mayr-Fitch, 1876, The Ent. 9: 122, 146, fig. 50. Wachtl, 1876: 6, 15, 21, 23, 25. Adler, 1877, Deut. Ent. Zeitschr. 21: 241 (err.!). Katter, 1877, Ent. Nachr. 3: 153. Adler, 1877, in Ent. Month. Mag. 14: 44. Lichtenstein, 1877, Bull. Soc. Ent. France 1877: 91. Katter, 1878, Ent. Nachr. 4: 6. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28: 319. Mayr-Fitch, 1878, The Ent. 11: 226. Uhlmann, 1880, Mitt. Schweiz. Ent. Ges. 1880: 29. Fletcher, 1880, The Ent. 13: 12. Adler, 1881, Zeitschr. wiss. Zool. 35: 189, pl. 11 fig. 15 (♀, ⊕, biol.). McLachlan, 1881, Ent. Month. Mag. 17: 259. Mayr, 1881, Gen. gallenbew. Cynip.: 36. Adler, 1881, Ent. Nachr. 7: 122. Adler-Lichtenstein, 1881, Génér. Altérn.: 51, pl. 11 fig. 15 (♀, ⊕, biol.). Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀). Rolfe, 1883, The Ent. 16: 30. Beyerinck, 1883, Ver. Akad. Amsterdam 22: 37, 102. Fockeu, 1889, Hist. Galles: 23, 45, 92-93 (⊕ histol.). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: exc. 168 (⊕ histol.). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 32. Cameron, 1891, Trans. Manchester Micro. Soc. 1891: 67, 68, pl. 4 fig. 16. Liebel, 1892, Ent. Nachr. 18: 274. Cameron, 1893, Brit. Phytoph. Hymen. 4: 27, 67, 122, 124, pl. 2 fig. 1 (♀, ⊕). Dalla Torre, 1893, Cat. Hymen. 2: 52. Adler-Straton, 1894, Altern. Gener.: XXXIII, XXXVI, 64, pl. 2, fig. 15 (♀, ⊕, biol.). Riley, 1895, Science n.s. 1: 463. Riedel, 1896, Gallen und Gallwespen: 21, 24, pl. 4 fig. 29. Thomas, 1897, Sitz.-Berich. Ges. Fr. Berlin 1897: 46. Appel, 1898, Schriften Physikal.-ökon. Ges. 39: 96. Massalongo, 1898, Malpighia 11: 17. Dalla Torre, 1898, Cat. Hymen. 5: 176, 283, 293, 294, 297, 326, 327, 333, 342. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 1-8. Kieffer, 1899, Bull. Soc. Rouen 34: 98. Oudemans, 1900, Nederland. Ins. : 749. Kieffer, 1901, André Hymén. Europe 7 (1): 123, 176, 193, 628, pl. 19 fig. 1 (♀, ⊕). Cameron, 1901, The Ent. 34: 271. Kieffer, 1901, Ann. Soc. Ent. France 1901: 446. Darboux and Houard, 1901, Zoocécid. Europe: (309?), 341, fig. 607, 608. Connold, 1902, Brit. Veget. Galls: 306. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: (40?), 41. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Kieffer, 1903, André Hymén. Europe 7 (2): 678. Blösch, 1903, Mitt. Schweiz. Ent. Ges. 11: 51. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 574. Stefani, 1904, Marcellia 3: 69. Trotter and Cecconi, 1904, Marcellia 3: 80. Rössig, 1904, Von weichen Organen . . . : 11. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55: 546. Trail and Rolfe, 1906, Bull. Misc. Inf. Kew 5: [acc. Marcellia 5: IX]. Schmidt, 1907, Zeit. Insektenbiol. 3: 348. Schmideknecht, 1907, Hymen. Mit-

teleuropas: 398. Connold, 1908, Brit. Oak Galls: 113, 131 (⊕). Houard, 1908, Zoocécid. Europe 1: 254, (291?), fig. 410-411. Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 102. Riedel, 1910, Gallen und Gallwespen: 9, 14, 24, 44, 81, 90, 94, pl. 4 fig. 33. Schulz, 1911, Festschr. Ver. Cassel, 1911: 159. Weidel, 1911, Flora (2) 2: 315-316, fig. 26. Dieroff, 1911, Bericht ent. Vereins Lepid. 30: 38. Küster, 1911, Gallen der Pflanzen: 12, 42, 82, 165, 228, 229, 351, 353, 389, 400, fig. 79, 101a. Swanton, 1912, Brit. Plant Galls: 32, 39, pl. 22 fig. 3, 4. Dittrich and Schmidt, 1913, Jahresber. Schlesisch. Ges. 1913: 110. Trotter, 1923, Marcellia 19: 144.

Cynips (Dryophanta) longiventris Kaltenbach, 1874, Pflanzenfeinde: 665, 791.

Diplolepis longiventris Karsch, 1880, Zeitschr. gesammt. Naturw. 5: 294. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 348, 624, 764, 779, 783, 789, fig. 63, 64 (♀, ⊕). Houard, 1912, Marcellia 11: 34, fig. 20-21 (corrected in Houard 1919: 10). Borcea, 1912, Zoocecid. România: 79. Kieffer, 1914, Schröder Ins. Mitteleurop. 3 (3): 20, 31, 45, 63, 69, pl. 1 fig. 17 (♀, ⊕). Bayer, 1914, Moravské Hálky: 77. Hedicke, 1915, Zeit. Insektenbiol. 11: 23. Houard, 1915, Marcellia 14: 99. Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66: 103. Ross, 1916, Pflanzengallen Bayerns: 67, fig. 217 C. Baudys, 1916, Verh. zoo.-bot. Ges. Wien 66: 79, 81. Hedicke, 1917, Stettiner Ent. Zeit. 78: 253. Houard, 1919, Marcellia 16: 132. Houard, 1919, Marcellia 17: 10. Hedicke, 1922, Deutsch. Ent. Zeitschr. 1922: 276. Ross, 1922, Deutsch. Ent. Zeitschr. 1922: 293. Hedicke, 1922, Konowia 1: 36. Houard, 1922, Marcellia 19: 78. Hoffmeyer, 1925, Ent. Meddel. 16: 7. Baudys, 1925, Publ. Inst. Phytopath. Brno C 39: 26, 28. Baudys, 1926, Bull. École Supér. Brno C 7: 38. Jaap, 1927: 177. Bischoff, 1927, Biol. Hymen. : 119. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 229, pl. 7 fig. 141, 142. Tavares, 1928, Broteria 25: 41, fig. 42, pl. 3 fig. 10-12.

Dryophanta similis-longiventris Bayer, 1909, Verh. zoo.-bot. Ges. Wien 59: 119. Bayer, 1910, Marcellia 9: 93, 100.

Dryophanta similis form *longiventris* Swanton, 1912, Brit. Plant-Galls: 168.

Cynips longiventris form *longiventris* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

FEMALE.—Nearly identical with the Central European *Cynips folii folii,* differing in its smaller size and more slender body, and in the scutellum which is smoother and more naked, especially anteriorly; with a bare suggestion of a depression along the median line anteriorly. Differs from *C. longiventris forsiusi* in having the entire body more rufous tho often with considerable rufo-piceous and black; the mesonotum including the scutellum largely hairy altho smooth and shining between the punctations from which the hairs arise, most closely punctate anteriorly especially along the parapsidal grooves; the anterior parallel and lateral lines prominent, broad, smooth and naked; the length 2.5

to 3.8 mm., the insects smaller than *folii,* distinctly larger than *forsiusi.* Figures 83, 97.

GALL.—As described for the species; the colored bands rather dark and well-defined; the galls fairly large, up to 10.0 mm. in diameter. On the leaves of *Q. pedunculata* and *Q. sessiliflora.* Figures 122, 130-132.

RANGE.—England: Derbyshire, and near Watford (Herts) (acc. Rolfe 1883). Hastings (acc. Connold 1908). South Norwood (acc. Müller 1870: 108). Kew (acc. Trail and Rolfe 1906). Lymm (acc. Cameron 1891). Worcestershire (acc. Fletcher 1880).

Denmark: northern Bornholm, Nylarsker, Almindingen, Svaneke-Listed, and Hammershus (acc. Bayer 1909). Skelser Skov, Basnaes, Strödam in Sjelland, Skelskör, Fulrendal, Stiznaes in Sjelland, and Bromme (Hoffmeyer in Kinsey coll.).

FIG. 17. VARIETIES OF CYNIPS LONGIVENTRIS
Possible extensions of known ranges shown by shading.

Belgium (Van Segvelt acc. Darboux and Houard 1907).

France: Alençon (acc. Houard 1915). Lorraine (acc. Liebel 1892). Petites-Dalles in Seine-Inf. (acc. Kieffer 1899). Royat and Lyon (acc. Tavares 1928).

Germany: Danzig (in Mus. Comp. Zool.?). Near Segeberg, Eutin, Kellersee, Lütjenburg, Neustadt, and Niendorf (acc. Jaap 1927). Nassau (acc. Schenck 1865). Schleswig (acc. Adler 1881). Freiburg i. B. (acc. Rössig 1904). Solingen (P. Eigen in Kinsey coll.). Zehlendorf (acc. Hedicke 1915). Briselang near Berlin (Braun acc. Hieronymus 1890). Gartzer Schrey an der Oder (acc. Hedicke 1917). Berlin (gall ex Forsius in Kinsey coll.). Near Mittenwalde (acc. Hedicke 1922). Clessin in Brandenburg (acc. Ross 1922). Zwickau, Halle,

Borna, Penig, and Freiberg in Saxony (acc. Schlechtendal 1870). Bavaria (acc. Ross 1916). Goseck in Thuringen and Schmiedeberg in Brandenburg (acc. Weidel 1911). Kreis Trebnitz and Schmiedeberg in Silesia (acc. Hieronymus 1890). Trachenberge near Dresden (acc. Riedel 1896). Dresden, Moritzburger Wälder, Berggiesshübel, Bautzen, and Lobenstein (acc. Riedel 1910). Grünberg in Silesia (acc. Schmidt 1907). Zobten, Naumberg a. B., and Niesky in Silesia (acc. Dittrich and Schmidt 1909). Sagan (acc. Riedel 1910). Tharandt (Baer acc. Riedel 1910). Lobenstein (acc. Dieroff 1911). Neustadt in Silesia (acc. Dittrich and Schmidt 1913). Meckbach, Kuhberg, Rehkaude, Saurasen, Habichtswald, near Zeche Marie, Söhre, and Oberkaufungen (acc. Schulz 1911).

Switzerland: Bern (acc. Uhlmann 1880). Laufenberg (acc. Blösch 1903).

Italy (acc. Trotter and Cecconi 1904).

Austria: Steiermark (acc. Mayr 1872). Leitha Gebirge (acc. Mayr 1871). Dölsach in Tyrol (acc. Mayr 1905). Bregenz (acc. Rössig 1904). Vienna and Neusiedlersee (acc. Mayr 1878).

Czecho-Slovakia: Platz in Bohemia (Wennermacher acc. Hieronymus 1890). Brandys nad Labem, east of Prague, Jicín, Turnov, Mnich. Hradiste, and Sobotka (acc. Bayer 1910). Slęzsku, Trest, Brno, and Kurim (acc. Baudys 1925). Chlumec n. Cidl., Jindr. Hradec, Lysá n. Lab., Ml. Boleslav, Roszdalovice, Kopidlno, Sychrov (acc. Baudys 1926). Kunetickah, Nechanice, Eisenstadtl, near Jicín, and Hodkovice n. Moh. (acc. Baudys 1916). Also see Bayer, 1914, Moravské Hálky: 77.

Rumania: Hermannstadt (acc. Henrich 1916). Ungheni, Podul, Iloaiei, Vaslui, Stefaneschi, Neamt, Pashkani, Buhus, Roman, Bakau, Tulchea, Pitesti, Piatra-Olt, Dragashani, Baltatesti, and other localities (acc. Borcea 1912).

Hungary: Budapest (gall, Sajo in Kinsey coll.).

Servia (Trotter acc. Darboux and Houard 1907).

Bulgaria: Rumelia (Trotter acc. Darboux and Houard 1907).

Caucasus (Radoszkowski acc. Kieffer).

Finland: Lojo and Runsala (Forsius in Kinsey coll.).

Thruout more Central Europe, known from Asia Minor, northern Italy, and northern France to northern England and Denmark. At least in part replaced in Finland by variety *forsiusi;* not to be expected in the Mediterranean area of Europe. Figure 17.

ORIGINAL DESCRIPTION.—Hartig, 1840, Germar Ent. Zeit. 2: 188. C. LONGIVENTRIS m.: a Cyn. folii vix distinguenda, nisi antennis articulis 2 ultimis connatis, colore rufo capitis, thoracis pedumque magis extenso. Long. 1-1½ lin.

Die harten, auf der Unterseite etwas abgeplatteten, sonst kugeligen einkammerigen Gallen haben eine schöne rothe Farbe, welche durch mehr oder weniger concentrische, blassgelbe, meist etwas warzig erhabene Kreisbogen unterbrocken wird. Die grössten Gallen bis 4 Linien im Durchmesser. Häufig, doch einzeln.

Translation: Cynips longiventris, new species. Scarcely distinguishable from *Cynips folii* except by the fusion[?] of the last two an-

tennal segments, and in the greater extension of the rufous color on the head, the thorax, and the legs; length 2 to 3 mm.

The hard, monothalamous galls, which are spherical with a slightly flattened base, have a beautiful red color which is broken by more or less concentric, light yellow, and usually slightly warty bands. The galls are up to 8 mm. in diameter. Abundant, but they occur only singly.

TYPES.—Not designated and probably not in existence. Hartig's material from northern Germany.

The present descriptions are based on the published descriptions cited in the bibliography, and on insects and galls which I have from Germany, Hungary, Denmark, and Finland, bearing determinations by Forsius, P. Eigen, Sajo, and Hoffmeyer (as detailed with the distribution data).

INQUILINES.—*Synergus pallicornis* Hartig. Emerges in May (acc. Mayr 1872).

S. apicalis Hartig (Brischke acc. Kieffer 1901).

PARASITES.—*Callimome longiventris* Brischke (acc. Adler-Straton 1894).

Decatoma biguttata (Swederus) (Brischke 1882 acc. Dalla Torre 1898).

D. variegata Walker (= *D. signata* Nees) (Brischke 1882 acc. Dalla Torre 1898).

Elachistus cyniphidum Ratzeburg (Ratzeburg 1848).

Entedon cyniphidum Ratzeburg (acc. Ratzeburg 1848).

Eupelmus sp. Emerges the following February (acc. Wachtl 1876).

Eurytoma aciculata Ratzeburg (acc. Blösch 1903).

E. appendigaster (Swederus) (Hartig acc. Dalla Torre 1898).

E. rosae Nees. Emerges in May of the following year (acc. Mayr 1878).

Habrocytus saxeseni (Ratzeburg) (Brischke 1882 acc. Dalla Torre 1898).

Mesopolobus fasciiventris Westwood. Emerges in September of the same year (acc. Wachtl 1876).

Ormyrus nodulosus Fonscolombe. Emerges in May of the following year (acc. Mayr 1904).

O. punctiger Westwood (acc. Dalla Torre 1898).

Syntomaspis cyanea (Boheman). Emerges from March to June in the following year (acc. Mayr 1874).

S. lazulina Förster. Emerges in May and June of the following year (acc. Mayr 1874).

Torymus abdominalis Boheman. Emerges in August of the same year (acc. Mayr 1874). Emerges in September of the same year (acc. Wachtl 1876).

T. nigricornis Boheman (= *T. regius* Nees) (acc. Mayr 1874). Emerges in September of the same year (acc. Wachtl 1876).

The beautifully banded galls of this variety appear to be fairly common in Central Europe. Connold (1908) records

as many as eight galls on single leaves. The galls first appear in June (acc. Mayr 1871; June 30 acc. Connold 1908 for England). They are mature by August or September (acc. Schlechtendal 1870), falling to the ground with the leaves in October (acc. Kieffer 1901). At that season the adults are mature and, just as with most other *Cynips*, they then chew a passage to the inside of the epidermis of the gall, but it is not until late November or December that the insects break thru the epidermis and emerge from the galls. It is true that Schlechtendal (1870) assigns late August to late October as the emergence time for this species, but many of that author's records are earlier than the experience of other students would verify. Mayr (1882) says the insects come out of the galls late in the autumn; Adler (1881) found the adults emerging in November and December in Germany, and I have German material dated November 15 and 18. My Danish material (Hoffmeyer coll.) is dated November 22 and 30, and December 5, 7, 8, 10, 11, and 17. Kieffer (1901) said emergence was in December in Lorraine.

Adler made the only experiments we have on the alternation of this insect. In 1877 he found that the agamic females oviposited in the adventitious buds of the oak stems (and trunks) in quite the same way as he had observed for *folii*. But in the first experiments he failed to secure the bisexual galls, and he failed again in 1878. In 1879 he observed several ovipositions from which he secured two bisexual galls in the following April. The insects and galls and biology of this bisexual form are discussed in the following pages on the form *similis*.

The first histologic studies of this gall were made by Lacaze-Duthiers in 1853 (acc. Kieffer 1901). Fockeu (1889) has given us a more detailed account, noting that the gall tissues are very similar to those of *folii*—an account of which is given under that variety in the present paper. The sub-epidermal structures of *longiventris* are more solid and woody than in *folii*, as one may directly observe, and this seems to me to represent a fifth layer, a collenchyma layer not found in *folii*. Kustenmacher (1894 acc. Darboux and Houard 1907), Hieronymus (1890), and Weidel (1911) have given us less extended accounts of the anatomy of this gall.

Cynips longiventris variety **longiventris** bisexual form **substituta**, new name

Figures 17, 100

Spathegaster Taschenbergi err. det. Adler, 1877, Deut. Ent. Zeitschr. 21: 241. Adler, 1877, Ent. Month. Mag. 14: 44. Lichtenstein, 1877, Bull. Soc. Ent. France 1877: 91. Katter, 1877, Ent. Nachr. 3: 153. Katter, 1878, Ent. Nachr. 4: 6.

Spathegaster similis Adler, 1881, Zeitschr. wiss. Zool. 35: 190, pl. 11 fig. 15a (♀, ♂, ⊕, biol.). Adler, 1881, Ent. Nachr. 7: 122. Adler-Lichtenstein, 1881, Génér. Altérn.: 52, pl. 11 fig. 15a (♀, ♂, ⊕, biol.). McLachlan, 1881, Ent. Month. Mag. 17: 259. Beyerinck, 1883, Ver. Akad. Amsterdam 22: 37, 101 (⊕, biol.). Fockeu, 1889, Hist. Galles: 23 (⊕). Adler-Straton, 1894, Altern. Gener.: 66, pl. 2, fig. 15a (♀, ♂, ⊕, biol.). Riley, 1895, Science n.s. 1: 463. Connold, 1908, Brit. Oak Galls: 114, 131, pl. 52 B. Bayer, 1914, Moravské Hálky: 77.

Dryophanta similis Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀, ♂). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: exc. 167. Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 23. Cameron, 1891, Trans. Manchester Micros. Soc. 1891: 67, 69, pl. 4 fig. 16a. Liebel, 1892, Ent. Nachr. 18: 275. Dalla Torre, 1893, Cat. Hymen. 2: 54. Cameron, 1893, Brit. Phytoph. Hymen. 4: 28, 122. Riedel, 1896, Gallen und Gallwespen: 21, 26. Oudemans, 1900, Nederland. Ins. : 749. Kieffer, 1901, André Hymén. Europe 7 (1) : 108, 145, 174, 624, pl. 11 fig. 11, pl. 13 fig. 13 (♀, ♂, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 410. Darboux and Houard, 1901, Zoocécid. Europe: 329, fig. 570. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 42. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Kieffer, 1903, André Hymén. Europe 7 (2) : 677. Hennequy, 1904, Les Insectes: 401? Schmidt, 1907, Zeit. Insektenbiol. 3: 348. Schmiedeknecht, 1907, Hymen. Mitteleuropas: 398. Houard, 1908, Zoocécid. Europe 1: 238, fig. 354, 355. Riedel, 1910, Gallen und Gallwespen: 14, 22, 34, 81, 85, pl. 6 fig. 10. Küster, 1911, Die Gallen der Pflanzen: 42. Swanton, 1912, Brit. Plant-Galls : 32, 39, 168, pl. 22 fig. 1, 2. Trotter, 1923, Marcellia 19: 144.

Dryophanta longiventris (sex. gen.) Cameron, 1893, Brit. Phytoph. Hymen. 4: 124, pl. 2 fig. 1a (♀, ♂, ⊕).

Diplolepis longiventris (sex. gen.) Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 348, 743, 783, 788, fig. 61, 62, 211 A (♀, ♂, ⊕). Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3) : 63. Ross, 1916, Pflanzengallen Bayerns: 63. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 225. Tavares, 1928, Broteria 25: 45.

Diplolepis similis Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3) : 20, 23, 42, 63.

Cynips longiventris form *similis* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

[NOT *Cynips q. similis* Bassett, 1864, Proc. Ent. Soc. Phila. 3: 685.]

FEMALE AND MALE.—Differing from the bisexual adults of *C. folii* form *taschenbergi* only in having the legs duller yellow, with the femora yellowish brown to brownish piceous, this difference more apparent in the females than in the males. Differing from the bisexual adults of *C. divisa* form *verrucosa* in having the mesonotum and mesopleuron entirely smooth and shining. Figure 100.

GALL.—Very similar to the galls of the bisexual forms of *Cynips folii.* Dull green in color, with a rather long, gray pubescence, and a sharply pointed tip; up to 20. mm. in length. On the bark at the bases of older stems or (less often) two year old stems; on *Quercus pedunculata* and *Q. sessiliflora.*

RANGE.—Probably that of the agamic form *longiventris* (fig. 17) which is confined to more Central Europe and which is not known in the Mediterranean area. The bisexual form *substituta* is known definitely from:

England: southern part (acc. Connold 1908).

Holland (acc. Beyerinck 1883).

Denmark: Basnaes and Stiznaes (Hoffmeyer in Kinsey coll.).

France: Lorraine (acc. Liebel 1892).

Germany: Schleswig (acc. Adler 1881; types). Lobenstein (acc. Dierdoff 1911). Dresden (Baumwiese acc. Riedel 1910). Bautzen (Mönchsw. and Berg acc. Riedel 1910). Tharandt (Baer acc. Riedel 1910). Lobenstein (Reuss acc. Riedel 1896). Bavaria (acc. Ross 1916).

Austria-Hungary (acc. Houard 1908).

ORIGINAL DESCRIPTION (of *similis*).—Adler, 1881, Zeitschr. Wiss. Zool. 35: 190, pl. 11 fig. 15a. Galle: Ungefähr 2 mm lang, der vorigen ähnlich aber schlanker und mehr zugespitzt, von grünlich grauer Farbe und sammetartiger Oberfläche. . . . Übrigens ist die stärkere und längere Beharrung ein wesentlicher Unterschied von der Taschenbergi-Galle (Fig. 15a). . . . [Follows an account of the development of the gall and the insect biology]. . . . Wespe: Länge 2 mm, schwarz, Taschenbergi zum Verwechseln ähnlich, nur an der dunkleren Färbung der Beine zu unterscheiden; diese sind dunkler gelb, Schenkel und Tibien am Auszenrande schwärzlich.

Translation: Gall approximately 2 mm. in length, very similar to the preceding [*folii taschenbergi*] but more slender and more pointed, with a greenish gray color and velvety surface. . . . The more stiff and longer hairs constitute the prime difference from the gall of *taschenbergi.* . . . The wasp is 2 mm. in length, black, and very easily mistaken for *taschenbergi* from which it is to be distinguished only by its darker legs; these are dull yellow, with the femora and tibiae blackish on the margins.

TYPES.—Of *similis:* 9 insects designated as types in the Vienna Museum (acc. F. Maidl in litt.). From Schleswig, Germany; Adler collector. Now designated as types of the new name *substituta.*

The present descriptions are based on the published descriptions cited in the bibliography, and on six insects which I have from Den-

mark (E. B. Hoffmeyer coll.) from a locality about a hundred miles from the type locality of *similis*.

PARASITE.—*Platygaster instricator* (acc. Hennequy 1904).

Adler discovered this insect as a result of his experimental breeding from the agamic *longiventris* in the spring of 1880. He found the adults emerging from the galls in May, about two weeks before he secured adults of the bisexual form of *folii* in that same year. But since Adler's single record seems to be the basis of all the other published emergence data for *substituta*, and since the Danish material in my collection (Hoffmeyer coll. and det.) is dated as late as May 31, June 2, and June 4 while *taschenbergi* distributes its emergence from May 25 to June 11 even in Denmark (not far from Adler's locality in Germany), we are unwarranted in concluding (as previous literature does conclude) that there is any great difference in the emergence dates of the two insects.

Adler saw *substituta* oviposit to give rise to the agamic *longiventris* only by an accident in connection with his experiments on the succession of *taschenbergi* and *folii*. In 1876 he placed what he took to be *taschenbergi* adults on the leaves of an oak from which he later secured galls of *longiventris*. His further work on *longiventris* having shown the very close similarity of both galls and insects of *taschenbergi* and *substituta*, we may conclude that Adler had really discovered the alternation of our present species. The data are, however, scant enough to encourage some one in Europe to repeat the work.

The gall of *substituta* is said (Adler 1881 and Hieronymus 1890) to differ from that of *taschenbergi* in nothing more than the few characters which I have given above. Adler considered that the insects of the two could be distinguished by the leg coloration which I have noted (with corrections) above. Mayr (1882) put *taschenbergi, flosculi, similis*, and *verrucosa* in a single paragraph with a remark about "Die hierhergehörenden Arten, welche ich nicht sicher zu unterscheiden im Stande bin . . . ," meaning that he was unable to distinguish these insects; but the Kieffer (1901) and Dalla Torre and Kieffer (1910) monographs arrive at the conclusion that these bisexual insects *are* indistinguishable. I have only six adults of *similis*, but eighty-five adults of *taschenbergi*, and it seems to me that every one of the females can be distin-

guished by the leg coloration. The males are less distinct, differing in my material only in averages in color. Nevertheless, the insects and galls of *similis* and *taschenbergi* are so nearly identical that they will undoubtedly be confused, and as a result our biologic data must always be open to correction.

Lacaze-Duthiers (1853) and Hieronymus (1890) give short accounts of the histology of this gall, mentioning the cells of the epidermis which produce the pubescence on the gall, the chlorophyll in the parenchyma under the epidermis, the later development of large calcium oxalate crystals in the cells of the parenchyma, and the nutritive material inside the gall.

Adler's name *similis* (1881) for this insect is pre-occupied in the genus *Cynips* by Bassett's *similis* (1864), so we have introduced *substituta* as a new name for Adler's insect.

Cynips longiventris variety **forsiusi,** new variety

agamic form

Figures 17, 98

Cynips (Diplolepis) longiventris err. det. Forsius, 1921, Meddel. Soc. Fauna et Flora Fennica 46: 32.

FEMALE.—The entire body averaging darker, in some cases largely black; the mesonotum largely naked except at the sides, but the surface distinctly coriaceous or even shagreened in places, especially along the parapsidal grooves, most so anteriorly; the anterior parallel and lateral lines not prominent, not broad nor smooth; the length 1.9 to 2.5 mm., the insects distinctly smaller than in the variety *longiventris*. Figure 98.

GALL.—As described for the species, the known specimens not as definitely marked, much smaller, up to 4.5 mm. in diameter. On *Quercus pedunculata*.

RANGE.—Finland: Helsingfors, Munksnäs, Granö, Malm (acc. Forsius 1921). Pargas (A. Nordman, from Forsius in Kinsey coll.). Lojo (Forsius; types).

Denmark: Stiznaes in Sjelland, Bromme (Hoffmeyer in Kinsey coll.).

Probably restricted to a more northern area in Europe near the northern limits of oaks. Figure 17.

TYPES.—15 females, no galls. The holotype and paratypes at the University of Helsingsfors; paratypes in the Kinsey collection. Labelled Lojo, Finland, R. Forsius collector.

In 1921 Dr. Runar Forsius, of Fredriksberg in Finland, reporting the occurrence of *longiventris* in the neighborhood of Helsingfors in the southern part of his native country, gave

us our most northern record for an oak-inhabiting cynipid. Upon examining the material which Dr. Forsius was good enough to send me, I find that most of it is distinct from the typical material of Central Europe. I am dedicating the new variety to Dr. Forsius to whom we are indebted for much information on the northern distribution of many other Hymenoptera. I understand that oak does not extend north of the very southern end of Finland, and we are fortunate in having cynipid material from that area.

Forsiusi insects are far more distinct from the Central European *longiventris* than *longiventris* is from the Central European *folii* or the Mediterranean *pubescentis* (insects). The galls, however, prove the relation of *forsiusi* to *longiventris*, their origin from a common stock, and perpetuation by isolation in what seem to be two distinct faunal areas of Europe.

Of the ten insects I have from Lojo, Finland, one is intermediate between *forsiusi* and typical *longiventris*. Three insects from Runsula in southwestern Finland approach typical *longiventris*. In a series of 88 adults of this species which I have from Denmark (Hoffmeyer coll.) there are five insects which approach typical *forsiusi*, a single insect which seems intermediate between *forsiusi* and *longiventris*, and 82 insects which are the Central European *longiventris*. There is apparently some transition area between the more northern and Central European faunas, but this probably does not extend south of Denmark.

Forsius records the occurrence of these galls in September, and the emergence of the adults on October 31 and November 1. This emergence is earlier than that for the typical *longiventris*. This matches our experience with many American Cynipidae among which there are some cases of the northern varieties emerging as much as two and a half months earlier than the corresponding varieties of the southern United States.

Cynips (Cynips) divisa Hartig
agamic and bisexual forms

AGAMIC FEMALE.—The entire insect rich rufous and piceous (Central Europe) to entirely black (more northern Europe); the head a little narrower than the rather stout thorax (Central Europe) or no

narrower (more northern Europe); the mesonotum in large part or almost entirely smooth, naked, shining; the abdomen fully twice as long as high, produced dorsally but with the second segment reaching only two-thirds or less of the way to the tip of the abdomen; the tip of the second abscissa of the radius prominently bent or enlarged (Central Europe) or not at all enlarged (more northern Europe); the length 1.8 to 4.0 mm. in two varieties.

The Central European variety *divisa (q.v.)* is close to the other varieties of *Cynips* in the same region; the more northern variety *atridivisa* is very near *C. folii atrifolii* and *C. longiventris forsiusi* of that region.

BISEXUAL FEMALE AND MALE.—As described for the genus and subgenus *(q.v.)*. Very similar to the bisexual forms known for other species of European *Cynips;* recognizable by the characters given, differing in having the mesonotum somewhat roughened especially anteriorly about the parapsidal grooves, the mesopleuron with a limited rough spot, and the tip of the second abscissa of the radius with, perhaps, a more distinct sort of triangulate enlargement.

AGAMIC GALL.—In form a more or less flattened sphere or ellipsoid, not as soft as *folii;* regular in shape, not distorted in drying, up to 7.0 mm. but usually under 5.0 mm. in its longest axis; entirely smooth and naked, at first bright red in color, becoming a light rosy brown or a straw brown. The outer shell thin but distinct from the spongy, not very solid layer beneath; a large part of the gall occupied with the larval cell which is central, oval, averaging 2.5 by 4.0 mm., the cell with a distinct but inseparable wall. The galls attached to the leaf veins, on the under surfaces of the leaves of *Quercus pedunculata, Q. sessiliflora,* and *Q. pubescens.* There are records for other hosts which may apply to undescribed varieties of *divisa.*

BISEXUAL GALL.—An irregularly cylindrical, more or less subdivided cell on the edge of a young leaf, in a bud, or on a young shoot; characterized in more detail under the descriptions of *Cynips divisa divisa* form *verrucosa.*

RANGE.—The species known thruout Europe wherever collections have been made on oaks, and from northern Africa and Asia Minor. This range probably involves several varieties, only two of which are described.

Altho the galls of *divisa* are so much smaller and consequently less conspicuous than those of *Cynips folii,* they seem to be fully as common thruout all parts of Europe in which cynipid collections have been made. Usually 10 to 15, but at times as many as 35 (acc. Connold 1908), or even 40 or more galls (acc. Schmidt 1907) may be found on a single leaf. The similar galls of *Cynips agama* are to be distinguished from *divisa* by their smaller size, thinner walls, and more ellipsoidal

shape. The superficially similar galls of *Cynips disticha* are always to be distinguished from both *divisa* and *agama* by the two cavities of *disticha,* one of which is the larval cell and the other a secondary cavity in the gall.

As usual, the Central European variety, *divisa,* is best known. Its alternate generation is recognized. We have some material of a distinct variety, *atridivisa,* from more northern Europe, and there are a dozen records testifying to the occurrence of a gall similar to *divisa* in Mediterranean Europe, Asia Minor, and northern Africa. These southern records are as follows:

Undescribed varieties of Cynips divisa

Dryophanta divisa Rolfe, 1881, The Ent. 14: 56, 57 (*Q. lusitanica, Q. glandulifera* in Kew gardens). Kieffer, 1901, André Hymén. Europe 7 (1): 638 (*Q. lusitanica, Q. Mirbecki,* Spain, Portugal, and Algeria records only). Darboux and Houard, 1901, Zoocécid. Europe: 305, 311, 354. Trotter, 1901, Bol. Soc. Brot. 18: 7. Darboux and Houard, 1902, Zoocec. Hilfsbuch: 40, 43. Tavares, 1902, Rev. Sci. Nat. S. Fiel 1: 115 (Portugal). Trotter, 1902, Marcellia 1: 124 (Spain, *Q. pedunculata*). Darboux and Houard, 1907, Galles de Cynipides: 241 (Records for Spain, Portugal, and Italy). Houard, 1908, Zoocécid. Europe 1: 279, 312, 318 (Records for *Q. Toza, Q. lusitanica, Q. macranthera,* incl. Asia Minor).

Dryophanta agama err. det. Tavares, 1902, Ann. Sci. Nat. Porto 7: 49 (corrected in Tavares, 1902, Rev. Sci. Nat. S. Fiel 1: 115).

Dryophanta verrucosa Darboux and Houard, 1907, Galles de Cynipides: 249 (Italian record only).

Diplolepis divisa Dalla Torre and Kieffer, 1910, Das Tierreich 24: 349, 764, 779, 781 (Medit. data only, incl. Sicily). Houard, 1913, Marcellia 12: 36 (Morocco). Houard, 1914, Nouv. Arch. Mus. Paris (5) 6: 146 (Corsica). Houard, 1914, Marcellia 13: 123. Houard, 1922, Zoocécid. Afrique, 1: 122, 131, 133, fig. 210, 211 (incl. Tunis). Tavares, 1928, Broteria 25: 27, fig. 37, pl. 3 fig. 7, 20, 20a, 22 (Portugal and Spain on *Q. pedunculata* and *Q. lusitanica*).

Very few insects seem to have been bred from the galls of all these Mediterranean collections, and since many other Cynipidae have developed distinct varieties south of the Alps and Pyrennes, I suggest that the references to *divisa* in the Mediterranean area need re-determination from large series of insects compared with Central European material. The records suggest the existence of host as well as geographic varieties in southern Europe.

Cynips divisa variety divisa

agamic form divisa Hartig

Figures 18, 84, 102, 118, 135

——[no name] Réaumur, 1737, Mém. Ins. 3:445, pl. 35 fig. 3, pl. 45 fig. 1. Lacaze-Duthiers, 1853, Ann. Sci. nat., Bot. (3) 19:301 (pl. 2 fig. 8 or 9?).

Cynips divisa Hartig, 1840, Germar Ent. Zeit. 2: 188 (♀, ⊕). Hartig, 1841, Germar Ent. Zeit. 3: 325, fig. 2-6, 9, 10. Hartig, 1843, Germar Ent. Zeit. 4: 398, 406. Ratzeburg, 1848, Ichneum. Forstins. 2: 203, 217. Ratzeburg, 1852, Ichneum. Forstins. 3: 243, 254. Snellen von Vollenhoven, 18—, Iets over Galnoten: 8. Reinhard, 1865, Berliner Ent. Zeit. 9: 6. Schenck, 1865, Jahrb. Ver. Nassau 17-18: 148, 157, 158, 175, 180, 223, 227, 250 (♀, ⊕). Taschenberg, 1866, Hymen. Deutsch.: 144. Smith, 1867, Ent. Month. Mag. 3: 182. Müller, 1872, Ent. Ann. 1872: 7. Kaltenbach, 1874, Pflanzenfeinde: 667, 792. Leunis, 1886, Thierkunde 2: 265 fig. 247b. Eckstein, 1891, Pflanzengallen und Gallentiere: 6. Schenkling, 1896, Ill. Wochenschr. Ent. 1: 220, fig. 1b. Dalla Torre, 1898, Cat. Hymen. 5: 130.

Cynips disticha err. Hartig, 1841, Germar Ent. Zeit. 3: 324.

Dryophanta divisa Mayr, 1871, Mitteleurop. Eichengallen: 37, pl. 5 fig. 51 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 689, 708, 710, 712. Mayr, 1874, Verh. zoo.-bot. Ges. Wien 24: 60, 80, 92, 97, 98. Newman, 1874, The Ent. 7: 25. Rudow, 1875, Archiv. Naturg. Mecklenburg 29: 33, 56. Mayr-Fitch, 1876, The Ent. 9: 122, 147, 149, fig. 51. Wachtl, 1876: 6, 21, 23, 25. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28: 319. Mayr-Fitch, 1878, The Ent. 11: 226. Uhlmann, 1880, Mitt. Schweiz. Ent. Ges. 1880: 30. Fletcher, 1880, The Ent. 13: 12. Mayr, 1881, Gen. gallenbew. Cynip.: 36. Rolfe, 1881, The Ent. 14: 54, 55. Adler, 1881, Zeitschr. wiss. Zool. 35: 191, 237, pl. 11 fig. 16 (♀, ⊕, biol.). Adler, 1881, Ent. Nachr. 7: 122. Adler-Lichenstein, 1881, Génér. Altérn.: 53, 112, pl. 11 fig. 16 (♀, ⊕, biol.). McLachlan, 1881, Ent. Month. Mag. 17: 259. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀). Rolfe, 1883, The Ent. 16: 30. Beyerinck, 1883, Ver. Akad. Amsterdam 22: 25, 34, 37, 96. Fockeu, 1889, Hist. Galles: 23, 45, 91, fig. 19 (⊕ histol.). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: exc. 171, 183 (⊕ histol.). Cameron, 1891, Trans. & Ann. Rpt. Manchester Micros. Soc. 1891: 67, 68, pl. 4 fig. 17. Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 32. Liebel, 1892, Ent. Nachr. 18: 275. Cameron, 1893 (agamic gen.), Brit. Phytoph. Hymen. 4: 27, 65, 67, 122, 127, pl. 2 fig. 4, pl. 16 fig. 1 (♀, ⊕). Dalla Torre, 1893, Cat. Hymen. 2: 49. Adkin, 1894, The Ent. 27: 202. Adler-Straton, 1894, Altern. Gener.: XXXIII, 67, 145, pl. 2 fig. 16 (♀, ⊕, biol.). Riley, 1895, Science n.s. 1: 463. Beyerinck, 1896, Ver. Akad. Amsterdam (2) 5: 9. Riedel, 1896, Gallen und Gallwespen: 21, 42, pl. 4 fig. 30, 30a. Dalla Torre, 1898, Cat. Hymen. 5: 293, 294, 297, 310, 333, 342. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 3, 5, 6, 8. Küster, 1900, Flora

87: 155. Oudemans, 1900, Nederland Ins.: 749. Cameron, 1901, The Ent. 34: 272. Kieffer, 1901, André Hymén. Europe 7 (1) : 15, 124, 176, 193, 225, 638 (in part), pl. 19 fig. 2, 2a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 447. Darboux and Houard, 1901, Zoocécid. Europe: 297, 341, fig. 609, 610. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 39, 41. Connold, 1902, Brit. Veget. Galls: 306. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Mayr, 1903, Verh. zoo.-bot. Ges. Wien 53: 397. Blösch, 1903, Mitt. Schweiz. Ent. Ges. 11: 48, 51. Kieffer, 1903, André Hymén. Europe 7 (2) : 679. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 573, 579. Rössig, 1904, Von welchen Organen . . . : 9—61, fig. 1, 2, 4, 5, 10-12, 28, 29, 30a, 33, 36, 37. Ross, 1904, Gallenbild. der Pflanzen: fig. 2g (⊕). Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55: 545. Vogler, 1906, St. Gallen Jahrb. Naturw. Ges. 1905: 335. Trail and Rolfe, 1906, Bull. Misc. Inf. Kew Bot. Gard. (5) : [acc. Marcellia 5: IX]. Darboux and Houard, 1907, Galles de Cynipides: 241 (not all localities), pl. 20 fig. 7 (⊕). Schmidt, 1907, Zeit. Insektenbiol. 3: 346, 347. Schmiedeknecht, 1907, Hymen. Mitteleuropas: 397, 398. Houard, 1908, Zoocécid. Europe 1: 255, 291, fig. 412, 413. Connold, 1908, Brit. Oak Galls: 12, 16, 22, 112, 134, pl. 42 (⊕). Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 102. Houard, 1909, Marcellia 8: 71, fig. 18, 19. Riedel, 1910, Gallen und Gallwespen: 9, 24, 46, 81, 90, 94, pl. 4 fig. 36, 36a. Bayer, 1910, Marcellia 9:94. Schulz, 1911, Festschr. Ver. Cassel 1911: 159. Weidel, 1911, Flora (2) 2: 313-315, fig. 23-25. Küster, 1911, Die Gallen der Pflanzen: 42, 229, 230, 243, 251, 363, fig. 122a. Dieroff, 1911, Bericht. ent. Vereins. Lepid. 30: 39. Swanton, 1912, Brit. Plant-galls: 32, 39, pl. 22 fig. 12 (⊕). Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70: 238, 289. Trotter, 1923, Marcellia 19: 144. Schröder, 1928, Handbuch Ent. 1: 430, fig. 3, 19. Larue, 1928, Bull. Soc. Linn. Lyon 1928: 125.

Dryophantha divisa Wachtl, 1876: 16.

Cynips (Dryophanta) divisa Karsh, 1883, Die Insektenwelt :214.

Dryophanta foli err. Cameron, 1893, Brit. Phytoph. Hymen. 4: 5.

Diplolepis divisa Dalla Torre and Kieffer, 1910, Das Tierreich 24: 344, 349 (in part), 624, 625, 764 (in part), 776, 783, 786, 789, fig. 65, 66 (♀, ⊕). Houard, 1912, Marcellia 11: 35, 110. Borcea, 1912, Zoocecid. România: 78. Houard, 1914, Marcellia 13: 26. Kieffer, 1914, Schröder Ins. Mitteleurop. 3 (3) : 14, 20, 31, 46, 64, 69, pl. 1 fig. 4. Bayer, 1914, Moravské Hálky: 62. Hedicke, 1915, Zeit. Insektenbiol. 11: 23, 24. Houard, 1915, Marcellia 14: 99. Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66: 103. Ross, 1916, Pflanzen-gallen Bayerns: 67, fig. 219. Baudys, 1916, Verh. zoo.-bot. Ges. Wien 66: 79. Houard, 1919, Marcellia 16: 129. Houard, 1919, Marcellia 17: 11. Houard, 1921, Marcellia 17: 97. Houard, 1922, Marcellia 18: 9. Ross, 1922, Bericht. Bayerisch. Bot. Ges. 17: 127. Houard, 1922, Marcellia 19: 51, 78. Baudys, 1924, Acta Soc. Sci. Nat. Morav. 1 (2) : 13. Hoffmeyer, 1925, Ent. Meddel. 16: 7. Baudys, 1926, Bull. École Supér. Brno C 7: 38. Baudys,

1926, Bull. École Supér. Brno C 8: 12, 13. Bischoff, 1927, Biol. Hymen. :119. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 229, pl. 7 fig. 143, 144. Jaap, 1927: 177, 178.

Dryophanta verrucosa form *divisa* Swanton, 1912, Brit. Plant-galls: 167.

Diplolepis divisa Hedicke, 1915, Zeit. Insektenbiol. 11: 118. Hedicke, 1917, Stettiner Ent. Zeit. 78: 253.

Cynips divisa form *divisa* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

Dryophanta disticha err. Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 369.

FEMALE.—Head, thorax, and legs largely rufous with some rufo-piceous, the abdomen largely piceous with some rufo-piceous; head a little narrower than the rather robust thorax; mesonotum smooth and naked centrally but punctate and hairy anteriorly and laterally, the anterior parallel and lateral lines distinct; most of the mesopleuron more hairy than in *atridivisa;* the tip of the second abscissa of the radius prominently bent or with a triangulate enlargement; length 2.8 to 4.0 mm., averaging nearer 3.5 mm. Figures 84, 102.

GALL.—As described for the species; on the leaves of *Quercus pedunculata, Q. sessiliflora,* and *Q. pubescens.* Figures 118, 135.

RANGE.—England: Bollin Valley (acc. Cameron 1891). Lymm (acc. Cameron 1891). Kew (acc. Rolfe 1881). Worcestershire (acc. Fletcher 1880).

Denmark: Bromme, Strödam in Sjelland, Sorö, Brabrand, Marsellsborg, and Jexen (Hoffmeyer in Kinsey coll.).

Holland: Utrecht (acc. Beyerinck 1896).

Belgium (Van Segvelt acc. Darboux and Houard 1907).

France: Nord (acc. Fockeu 1889). Arques-la-Bataille (Bouvier acc. Houard 1914). Caen (Freyssenet acc. Houard 1922). Buchy (Noury in Kinsey coll.). Alençon (acc. Houard 1915). Bézu in Eure (Cornu acc. Houard 1922). Vosges (Puton acc. Houard 1912). Lorraine (acc. Liebel 1892). Bourg-le-Comte (acc. Larue 1928).

Germany: Schleswig (acc. Adler 1881). Danzig (in Mus. Comp. Zool.?). Near Segeberg, Niendorf, and Mölln (acc. Jaap 1927). Nassau (acc. Schenck 1865). Braunschweig (Hartig; types). Pfronten-Dorf (acc. Ross 1922). Halle (Schlechtendal acc. Riedel 1910). Solingen (P. Eigen in Kinsey coll.). Bleicherode (P. Eigen in Kinsey coll.). Near Berlin (Müllenhoff acc. Hieronymus 1890; also in Kinsey coll.). Steglitz (acc. Hedicke 1915). Thüringen (in Kinsey coll.). Winterstein in Thüringen and near Wittenberg in Saxony (acc. Weidel 1911). Buchheide and Gotzlow (acc. Hedicke 1917). Dresden (acc. Riedel 1896). Berggiesshübel (acc. Riedel 1910). Bautzen (acc. Riedel 1896). Freiburg in Baden (Braun acc. Hieronymus 1890). Gera (acc Dieroff 1911). Bavaria (acc. Ross 1916). Weimar (Haussknecht acc. Hieronymus 1890). Pirna (Magnus acc. Hieronymus 1890). Ochelhermsdorf in Silesia (Schröder acc. Hieronymus 1890). Near Grünberg in Silesia (Hellwig acc. Hieronymus 1890). Liegnitz (Gerhardt acc. Hieronymus 1890). Schmiedeberg, near Merzdorf, Stohnsdorf, Hirschberger Thal, and Vor-

der-Saalberg (all in Silesia; acc. Hieronymus 1890). Neusalz and Hirschberg (acc. Dittrich and Schmidt 1909). Rinkenkuhl am Hirschberg, Habichtswald, near Cassel, Meckbach, Gartenhecken, Krebsrück, Berggarten, Rehkaude, Saurasen, Kuhberg, and Park Wilhelmshöhe (all acc. Schulz 1911).

Switzerland: Bern (acc. Uhlmann 1880). Near St. Gallen (acc. Vogler 1906). Weihern (Müller acc. Vogler 1906). Laufenberg (acc. Blösch 1903).

Austria: near Vienna? (Mayr in Mus. Comp. Zool.). Bregenz (acc. Rössig 1904).

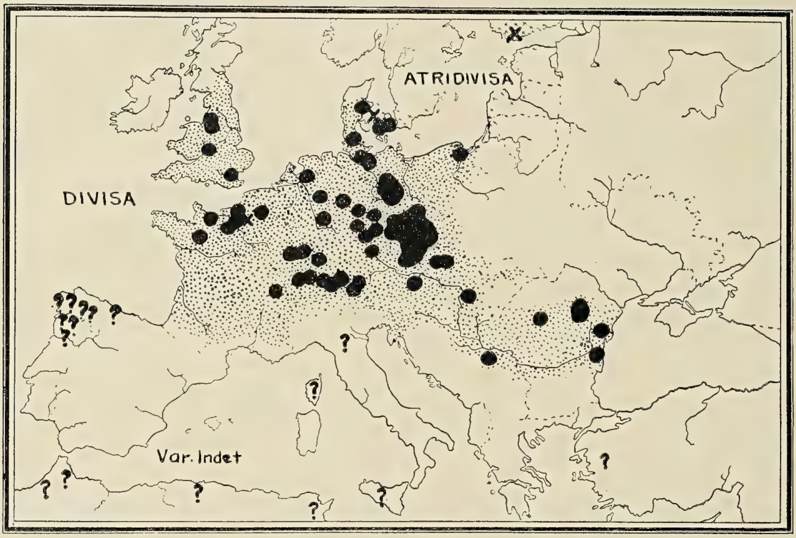


FIG. 18. VARIETIES OF CYNIPS DIVISA
Possible extensions of known ranges shown by shading.

Czecho-Slovakia: Brandys nad Labem, Králové Hradec, near Prague, east of Prague, Jicín, Zeleznice, Sobotka, and Turnov (all acc. Bayer 1910). Trebon (= Wittingau) (acc. Baudys 1916). Dévín (acc. Baudys 1924). Tábor, Horazdovice, Nov. Bydzov, Chlumec n. Cidl, Cimelic, Chotebor, Mt. Boleslav, Hodkovice n. Moh., Trest, and Brno (all acc. Baudys 1926). Also see Bayer, 1914, Moravské Hálky: 62.

Hungary (Paszlavszky acc. Kieffer 1901).

Jugo-Slavia (Servia; Trotter acc. Darboux and Houard 1907).

Rumania: Hermannstadt (acc. Henrich 1916). Eastern part (acc. Kieffer 1901). Neamtzu, Bakau, Vlasca, Tulchea and Muscel (acc. Borcea 1912).

Apparently confined to the *Q. Robur* group of oaks in more Central Europe. Known from Bulgaria and Servia to northern France, England, and Denmark. Not recorded from southern France. The records for other hosts in the Mediterranean area of Europe, Asia Minor, and northern Africa probably apply to undescribed varieties (see discussion above). Figure 18.

ORIGINAL DESCRIPTION.—Hartig, 1840, Germar Ent. Zeit. 2: 188. C. divisa m.: antennarum articulis 2 ultimis connatis, 4-7 elongatis, rufa, antennis, metathoracis declivitate, basi dorsoque abdominis, basi summa coxarum fusco-nigris. Long. 1½ lin.

Die einkammerige Galle kugelig, etwas niedergedrückt, von der Grösse einer Rehposte, glatt und fast glänzend, wie Aepfel mit kirschrothen Backen, fleischig abter hart, auf der Unterseite der Eichenblätter—nicht häufig—um Braunschweig.

Translation. Cynips divisa, new species. With the last two segments of the antennae united, segments 4 to 7 elongate; the insect rufous, with the antennae, the sides of the metathorax, the base and the dorsal surface of the abdomen, and the very bases of the coxae piceous black; the length 3 mm.

The monothalamous gall spherical, rather flattened, the size of deer shot, smooth and more or less shining, like an apple with bright red cheeks, fleshy but hard, on the lower surfaces of the oak leaves; not common; found around Braunschweig.

TYPES.—Not designated and probably not in existence. Hartig's material from Braunschweig, Germany.

The present descriptions are based on the published descriptions cited in the accompanying bibliography, and on several hundred insects and as many galls which I have from localities in Denmark, France, and Germany, determined by G. Mayr (Mus. Comp. Zool. coll.), Houard, Noury, Sajo, Forsius, P. Eigen, and Hoffmeyer, as detailed in the above distribution data.

INQUILINES.—*Synergus albipes* Hartig. Emerges in August of the same year (acc. Mayr 1872).

S. gallaepomiformis (Fonscolombe) (= *S. fascialis* Hartig) (acc. Blösch 1903).

S. pallicornis Hartig. Emerges in April of the following spring (acc. Mayr 1872).

S. tscheki Mayr. Emerges in March of the following spring (acc. Mayr 1872).

PARASITES.—*Decatoma biguttata* (Swederus) (acc. Mayr-Fitch 1876). Emerges the same fall or in April and June of the following year. (acc. Mayr 1905).

D. variegata Curtis (= *D. signata* Nees) (acc. Blösch 1903).

Eucoila basalis (Hartig) (Radoszkowski acc. Kieffer 1901). A parasite of the family Figitidae.

Eupelmus urozonus Dalman (acc. Adler-Straton 1894).

Eurytoma aethiops Boheman (acc. Blösch 1903).

E. appendigaster (Swederus) (Förster acc. Dalla Torre 1898).

E. rosae Nees (= *E. squamea* Walker). Emerges from July of the same year into the following spring; the earlier emergents at least are parasitic on the *Synergus* inquilines of the galls (acc. Mayr-Fitch 1876 and Mayr 1878).

E. setigera Mayr. Emerges in July and August of the same year (acc. Mayr 1878).

E. signata Kaltenbach (acc. Adler-Straton 1894).

Habrocytus saxeseni (Ratzeburg) (acc. Ratzeburg 1848). Emerges the same autumn.

Megastigmus dorsalis (Fabricius) (acc. Blösch 1903).

Mesopolobus fasciiventris Westwood (= *Pteromalus fasciculatus* Walker) (acc. Wachtl 1876). Emerges in the same autumn (acc. Kieffer 1901). Emerges the following March (acc. Wachtl 1876).

Ormyrus punctiger Westwood. Emerges in June of the following year (acc. Mayr 1904).

O. tubulosus Fonscolombe. Emerges in June or July of the following year (acc. Mayr 1904).

Pteromalus incrassatus Ratzeburg (acc. Ratzeburg 1852). Emerges in October and November of the same year, or April and May of the second year (acc. Mayr 1903).

Syntomaspis cyanea (Boheman). Emerges the following spring (acc. Mayr 1874). Emerges in April (acc. Wachtl 1876).

S. druparum (Boheman) (= *Torymus pubescens* Förster) (acc. Adler-Straton 1894). Emerges the same autumn.

S. lazulina Förster (Giraud 1877 acc. Dalla Torre 1898). Emerges the same autumn.

Torymus abdominalis Boheman (= *T. medius* Förster). Emerges in August of the same autumn (acc. Ratzeburg 1848 and Mayr 1874).

T. nigricornis Boheman (= *T. regius* Nees). Emerges in September and October of the same year (acc. Mayr 1874). Emerges the following March (acc. Wachtl 1876).

T. sapphyrina (Boheman) (= *Syntomaspis caudata* Mayr) (acc. Adkin 1894).

The well-known galls of this Central European variety appear in the middle of June, becoming mature by the end of August, at which time the adult insects are developed within the galls (acc. Rössig 1904). Rössig points out that in the first six weeks the larva attains a length of only 300 μ, but that in the next two weeks it reaches a length of at least 2 mm. Emergence occurs from mid-October to early December. There are records for emergence in Austria in October (acc. Mayr 1884), in late October and early November in northern Germany (acc. Adler 1881), from November 10 to 22 in England (acc. Mayr-Fitch 1876), and in early December in Lorraine (acc. Kieffer 1901). The dates on my Danish material (Hoffmeyer coll.) are October 10, 12, 16, 19, 26, and 30, and November 2, 3, 5, and 8. Réaumur (1737) and Schenck (1865) both recorded spring emergence, but the first record means little since there is internal evidence in the Mémoires that Réaumur never distinguished the true gall makers from the inquilines which emerge in the spring; and

altho we cannot raise the same question for Schenck's records, it seems not to have been verified by later experience.

According to Beyerinck (1883: 25) the abdomen of one of the larger agamic females may contain as many as 178 large eggs, altho a smaller individual may have only a score of eggs. Hartig (1840) first figured the structure of the abdomen of *divisa*, showing details of the ovipositor, eggs, and ovaries which we have copied in the present paper. Rössig (1904) used larvae of this species in his study of the origin of the gall-producing stimulus of gall wasps, and his paper gives many details of the larval structure of *divisa*, especially of its oenocytes and Malpighian tubules.

In the early search for the missing male of the gall wasps, Hartig gathered 28,000 galls of this species and bred between 9,000 and 10,000 adult insects which were, of course, all females. This observation attracted considerable attention at that time, and provided some impetus to the investigations which resulted in our present knowledge of alternation of generations among these insects. Hartig first recorded his observations as applying to the ordinarily rare wasp, *Cynips disticha*; but in 1843 (Germar Ent. Zeit. 4:398) he stated that the observations applied to *Cynips agama*. Mayr-Fitch (1876, The Ent. 9: 149) noted the correction, and later authors have accepted it.

Adler, in 1877, observed that the agamic *divisa* oviposits in unopened, terminal buds of the oak. Altho he obtained none of the galls of the alternate generation in these first experiments, his results in 1878 were more fortunate. The adults lived over a period of fourteen days during which a series of buds were pricked by the insects, and from these he obtained, on the young leaves in the following spring, five galls of *verrucosa*, the bisexual form described below.

The histology of the gall of *divisa* has been described by Lacaze-Duthiers (1853), Fockeu (1889), Hieronymus (1890), Kustenmacher (1894 acc. Kieffer 1901), and in more detail by Weidel (1911). These studies have all emphasized the similarity of *divisa* galls to those of *Cynips folii*, noting only such differences in epidermal coloring materials, more openly spongy parenchyma, hardness, size, and shape as are apparent in examining the gall with one's naked eye. Küster (1911) records only 53.5 per cent of water in these galls, which is

only one-half of one per cent more than the normal leaves may yield, and considerably less than the fresh, succulent galls of *folii* which may contain as much as 87.5 per cent water.

Cynips divisa variety divisa

bisexual form **verrucosa** (Schlechtendal)

Figures 18, 101

Spathegaster verrucosus Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 389 (♀, ♂, ⊕). Adler, 1881, Zeitschr. wiss. Zool. 35: 191, 237, pl. 11 fig. 16a (♀, ♂, ⊕, biol.). Adler, 1881, Ent. Nachr. 7: 122. Adler-Lichtenstein, 1881, Génér. Altérn.: 54, 112, pl. 11 fig. 16a (♀, ♂, ⊕, biol.). McLachlan, 1881, Ent. Month. Mag. 17: 259. Fockeu, 1889, Hist. Galles :23. Adler-Straton, 1894, Altern. Generations: 69, 145, pl. 2 fig. 16a (♀, ♂, ⊕, biol.). Riley, 1895, Science n.s.1: 463. Connold, 1908, Brit. Oak Galls: 112, 134.

Spathegaster verrucosa Mayr, 1871, Mitteleurop. Eichengallen: 50, pl. 6 fig. 73 (⊕). Rudow, 1875, Arch. Naturg. Mecklenburg 29: 39, 59. Wachtl, 1876: 17, 19, 22, 24, 26. Mayr-Fitch, 1877, The Ent. 10: 249, fig. 73. Beyerinck, 1883, Ver. Akad. Amsterdam 22: 37. Bayer, 1914, Moravské Hálky: 62.

Dryophanta verrucosa Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 35, 36 (♀, ♂). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68: exc. 170. Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 34. Cameron, 1891, Trans. & Ann. Rpt. Manchester Micros. Soc. 1891: 69. Cameron, 1893, Brit. Phytoph. Hymen. 4: 28, 122. Dalla Torre, 1893, Cat. Hymen. 2: 54. Riedel, 1896, Gallen und Gallwespen: 21, 47, pl. 4 fig. 44. Oudemans, 1900, Nederland. Ins.:749. Kieffer, 1901, André Hymén. Europe 7 (1): 121, 622, pl. 12 fig. 10 (♀, ♂, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 435. Darboux and Houard, 1901, Zoocécid. Europe: 345, fig. 632. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 42. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip. 53. Kieffer, 1903, André Hymén. Europe 7 (2): 677. Rössig, 1904, Von Welchen Organen. . . :11. Vogler, 1906, St. Gallen Jahrb. Naturw. Ges. 1905: 335. Darboux and Houard, 1907, Galles de Cynipides: 249, pl. 14 fig. 7, 8 (⊕). Fortwaengler, 1907, Zeit. Insektenbiol. 3: 130. Schmidt, 1907, Zeit. Insektenbiol. 3: 347. Schmiedeknecht, 1907, Hymen. Mitteleuropas: 398. Houard, 1908, Zoocécid. Europe 1: 261, fig. 436, 455, 456. Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 103, 105. Riedel, 1910, Gallen und Gallwespen:14, 25, 48, 81, 85, pl. 4 fig. 41. Küster, 1911, Gallen der Pflanzen: 42. Noury, 1911, Bull. Soc. Sci. Nat. Rouen 1911: 143. Swanton, 1912, Brit. Plant Galls: 32, 39, 167, pl. 22 fig. 9, 10, 11. Hedicke, 1915, Zeit. Insektenbiol. 11: 23. Trotter, 1923, Marcellia 19: 144.

Cynips (Spathegaster) verrucosa Karsch, 1883, Die Insektenwelt: 213.

Dryophanta verrucosas Cameron, 1891, Trans. & Ann. Rpt. Manchester Micros. Soc. 1891: 67, pl. 4 fig. 17a.

Dryophanta divisa (sex. gen.) Cameron, 1893, Brit. Phytoph. Hymen. 4: 127, pl. 2 fig. 4a, pl. 16 fig. 1a (♀, ♂, ⊕).

Diplolepis divisa (sex. gen.) Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 349, 756, 783, 789, fig. 174 B (♀, ♂, ⊕). Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3): 63. Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66: 104. Ross, 1916, Pflanzengallen Bayerns: 63. Houard, 1919, Marcellia 16: 139. Houard, 1919, Marcellia 17: 11. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 231. Tavares, 1928, Broteria 25: 31, fig. 33.

Diplolepis verrucosa Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3): 20, 44, 63, pl. 2 fig. 6 b.

Cynips divisa form *verrucosus* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 379.

FEMALE AND MALE.—Differing from the bisexual forms known for other species of European *Cynips* in having the mesonotum somewhat roughened especially anteriorly about the parapsidal grooves, the mesopleura with a limited rough spot, and the tip of the second abscissa of the radius with, perhaps, a more distinct sort of triangulate enlargement. Fig. 101.

GALL.—Irregularly cylindrical cells irregularly constricted to give the appearance of two or three fused cylinders, each conically tipped; up to 2.5 by 8.0 mm. in width and length; swollen a bit where it is attached to the leaf; green or reddish, slightly pubescent, set with minute, watery vesicles. Attached at the edge of a leaf, at the tip of a vein; rarely in the buds or on the young shoots. Known only from *Quercus pedunculata* and *Q. sessiliflora.*

RANGE.—Probably that of the agamic form *divisa* (fig. 18), which is confined to more Central Europe. The bisexual form *verrucosa* is definitely recorded from the following localities:

England: southern part (acc. Connold 1908).

Denmark (acc. Houard 1908).

Germany: Freiburg i. B. (acc. Rössig 1904). Halle (acc. Schlechtendal 1870). Near Berlin (acc. Schlechtendal 1870). Schleswig (acc. Adler 1881). Thuringen (in Kinsey coll.). Bavaria (acc. Ross 1916). Dresden (acc. Riedel 1910). Zwickau (acc. Schlechtendal 1870). Wartha, Zobten, and Neuwaldau (acc. Dittrich and Schmidt 1909). Grünberg in Silesia (acc. Schmidt 1907). Nisky in der Lausitz (acc. Schlechtendal 1870).

France: Normandy (acc. Noury 1911). Lorraine (Liebel acc. Riedel 1896).

Austria: Northern Tyrol (acc. Fortwaengler 1907).

Rumania: Hermannstadt (acc. Henrich 1916).

Czecho-Slovakia: (acc. Bayer 1914).

ORIGINAL DESCRIPTION.—Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 389. SPATHEGASTER VERRUCOSUS. N. SP.

Niger, antennis fusco-nigris, basi pallidiore; thoracis dorso nitido polito; mandibulis, squamulis vaginaque extrema testaceis, trochanteribus posterioribus, femoribus, basi picea excepta, tibiis tarsisque ferrugineis; coxis, trochanteribusque reliquis piceis, petiolo pallidiore. Alis subhyalinis, neuris fuscis, macula obscura in nervi analis medio. Antennis 15 articulatis in utroque sexu; abdomine ♂ petiolato, ♀ subsessili.

Longitudine corporis 2.5 Millimeter.

DIE WESPE. Kopf schwarz, matt, sehr fein und tief punktirt, die Umgebung der Augen schwach behaart, mandibeln rothgelb, Taster bleich. Die 15 gliedrigen Fühler sind schwach behaart, schwarzbraun, beim ♀ das erste bis vierte Fühlerglied, beim ♂ has erste und zweite, etwas lichter gefärbt, die Spitze des zweiten und die äusserste Basis des dritten gelbbraun. Der Thoraxrücken glatt, glänzend und durch zwei tiefe Furchen in drei Felder getheilt. Diese Furchen sind an der Spitze nur wenig flacher, als an der Basis. Nur an der Basis und neben den Furchen findet sich eine schwache Punktirung, die Scheibe erscheint selbst bei starker Vergrösserung glatt. Das Schildchen ist matt gerunzelt, schwarz, zuweilen an der Spitze braun, mit feiner greiser Behaarung, an der Basis jederseits ein flacher glänzender Quereindruck. Die Seiten des Vorder- und Hinterthorax sind gerunzelt; die des Mittelthorax glänzend, glatt. Die Schüppchen sind, wie die äusserste Spitze der Scheiden, rothgelb. Die Hauptfärbung der Beine ist ein helles Rostgelb, nur die Hüften, mit Ausnahme der Spitzen, die Schenkelringe der beiden vorderen Beinpaare, so wie der Grund der Schenkel pechbraun. Der Hinterleib des ♂ ist kurz gestielt, der Stiel blass-braun. Die Flügel kaum durch die Behaarung getrübt, die Adern matt, braun, etwas gelblich, in der Mitte der Analader ein unbestimmter, dunkler Fleck. Der Hinterleib des Weibchens fast sitzend.

Die Körperlänge 2½ Millim.

DIE GALLE. Anfang Mai, wenn sich die Blätter der Eichen anfangen zu entfalten, finden sich an den Rändern derselben, sowohl dem Haupt- als den Seitennerven entspringend, die kleinen 3—4 Millimeter grossen, zierlichen Gallen. Die äussere Gestalt ist entweder walzenförmig, an der Spitze und Basis verdickt, oder stumpf kegelförmig, nach unten schwach verengt, die Mitte am dicksten. Die Färbung ist anfangs dunkel blaugrün, spät grüngelb oder schwach röthlich. Was den Gallen ein hübsches Ansehen verleiht, ist die Beschaffenheit der Oberfläche, diese erscheint durch gehäufte, kleine, wasserhelle Bläschen, welche mit Flüssigkeit gefüllt sind, warzig gekörnt, rauh; zwischen diesen Bläschen stehen einzelne zerstreute Härchen. Die fleischig-saftige Hülle umschliesst eine cylindrische Larvenhöhle.

Translation. Black, with the antennae brownish black, paler basally; the mesonotum smooth and shining; the mandibles, tegulae, and the hypopygium [?] yellowish brown, the trochanters of the hind legs, the femora (excepting their piceous bases), the tibiae, and the tarsi brownish rufous; the coxae and all the other trochanters piceous, the petiole rather pale. The wings sub-hyaline, the veins fuscous, obscurely spotted at the middle of the anal vein. The antennae 15-segmented in

both sexes; the abdomen of the male petiolate, that of the female subsessile. Length 2.5 mm.

Wasp: Head black, feebly, very finely and deeply punctate, scatteringly hairy about the eyes, the mandibles rufous-yellow, the palps pale in color. The 15-segmented antennae are feebly hairy, dark brown, the first four segments in the female and the first two in the male somewhat lighter in color, the tip of the second and the very base of the third golden brown. The mesonotum smooth, shining, divided by two deep grooves into three distinct parts. These grooves are only a little shallower anteriorly than posteriorly. It is only at the base and about the grooves that there is a feeble punctation, the rest of the surface appearing smooth even with high magnification. The scutellum is finely rugose, black, sometimes brown at the tip, with a fine gray pubescence, the base always with a shallow, smooth and shining foveal grove. The prothorax and metathorax are rugose laterally, the mesopleura being smooth and shining. The tegulae and hypopygial spine are rufous. The legs are largely bright golden rufous, only the coxae, the trochanters of the front and middle pairs of legs, and the bases [?] of the femora [?] brownish piceous. The abdomen of the male is short petiolate, the petiole light brown. The wings are only faintly obscured with hairs, the veins being dull brown, slightly yellowish, the anal vein having a clouded spot at the mid-point. The abdomen of the female is almost sessile. Length 2.5 mm.

Gall: The small, graceful galls, 3 to 4 mm. in length, appear in May when the oak leaves first unfold, occurring on the edges of the leaves, developing either from the main veins or the lateral veins. In form the gall is either cylindrical, flaring at the tip and the base, or bluntly tipped and cone-shaped with the base slightly constricted and the middle thickest. The color is at first a dull blue-green, becoming yellowish-green or slightly reddish. What makes the gall especially attractive is the nature of the epidermis which appears warty or roughened with aggregations of small, perfectly clear vesicles which are filled with liquid; between these vesicles are a few stray hairs. The fleshy, succulent wall of the gall encloses a cylindrical larval cell.

TYPES.—5 insects in the Vienna Museum (acc. F. Maidl in litt.). The Schlechtendal material from Halle, near Berlin, and Zwickau in Germany.

The present descriptions are based on the published descriptions cited in the bibliography, and on four insects I have from Thuringen, Germany.

PARASITES—*Torymus abdominalis* Boheman. Emerges the same June (acc. Wachtl 1876).

Decatoma sp. Emerges the same June (acc. Wachtl 1876).

Eurytoma sp. Emerges in June (acc. Wachtl 1876).

The very attractive, leaf galls of this bisexual form of *divisa* are quite distinct in shape from the usually adventitious bud galls of the bisexual forms known for other European

Cynips. The galls of *verrucosa* are strictly leaf galls, the result of the oviposition of the agamic insect in the large terminal buds where the young leaves are fairly well developed, instead of in the undeveloped, adventitious buds patronized by *folii* and *longiventris.* Adler averred (1881) that even when the *verrucosa* galls appear to be on the young shoots, small axillary buds will be found in the angles between the galls and the shoots, evidencing the origin of the gall from young leaves.

The insects of *verrucosa* are easily recognizable from the bisexual forms of other European *Cynips.* Schlechtendal's original description (quoted above) is precise in its characterization of the adults, but the descriptions (both of the insects and the galls) in the later European work are poor and evidently not based on actual specimens.

The young galls appear when the buds of the oaks first open, which is late in April or early in May (acc. Schlechtendal 1870) in most of the range of the insect. Adler (1881) reported mature galls by the end of May with the insects emerging late in May or early in June. Schlechtendal's material emerged late in May.

Altho the galls of the agamic *divisa* are abundant in Central Europe, the collections of the bisexual form have been few, and this is one of the European cynipids that needs further observations. Adler showed that the agamic *divisa* gives rise to the bisexual *verrucosa,* but he did not obtain return data. There seems to be no reason for questioning this relation, altho experimental proof of it would be worth obtaining.

Cynips divisa variety **atridivisa,** new variety

agamic form

Figures 18, 103

FEMALE.—The entire body including the femora and tibiae piceous to back; head fully as wide as the rather slender thorax; mesonotum almost entirely smooth and naked with only a few stray hairs around the rim; the anterior parallel and lateral lines practically obliterated; the mesopleuron less hairy than in *divisa;* the tip of the second abscissa of the radius without any enlargement; length 1.8 to 2.8 mm., averaging near 2.0 mm.

GALL.—Apparently not different from that of variety *divisa,* unless it averages smaller; on *Quercus pedunculata.*

RANGE.—Denmark: Bromme (Hoffmeyer; types). Strödam in Sjelland (hybrids; Hoffmeyer in Kinsey coll.).

Finland: Lojo (hybrids; Forsius in Kinsey coll.).

France: Buchy (Noury in Kinsey coll.).

Probably in a more northern area, chiefly near the northern limit of oak in Europe.

TYPES.—35 females, no galls. Holotype and paratypes in the Kinsey collection; paratypes at the American Museum of Natural History, the U.S. National Museum, the British Museum, and the Vienna Museum. Labelled Bromme, Denmark; galls September 29, 1927; E. B. Hoffmeyer collector.

Among more than a thousand insects of the whole species *divisa* which I have from various localities in Denmark (all Hoffmeyer coll.), I find 35 specimens which are strikingly different from the Central European material in their much smaller size, nearly jet black color, more naked abdomens, and distinct wing venation. They indicate an hereditary development that has not been noted heretofore, as far as I can find, in *divisa* of more Central Europe. In this same material there are 178 specimens which are in one or more respects intermediate between typical *divisa* and *atridivisa* but close to *atridivisa*. I have only six insects of this species from Finland, all of which are similarly intermediates, but the occurrence of this same tendency in the Danish and Finnish material supports the idea that *atridivisa* is a distinct northern variety. This interpretation is also supported by the parallel occurrence of northern varieties of *folii* and *longiventris*. The single specimen of *atridivisa* and the single hybrid among the more than a hundred insects from northwestern France suggests that the northern form may have been pushed southward, during the Pleistocene glaciation, to hybridize with the southern relative, just as we have explained the hybrid *Cynips* in the United States (see pp. 55 to 60).

The data on the European insects are summarized in the following table.

Finland	6	insects,	0% *divisa,*	100% *hybrids,*	0% *atridivisa*
Denmark	1035	"	79% "	17% "	3.4% "
No. France	106	"	98% "	1% "	1% "
Germany	17	"	100% "	0% "	0% "

The galls of our type series of *atridivisa* were not isolated from those of the typical *divisa*, from which they probably do

not differ materially. The biology of the insect may also be expected to be similar to that of Central European material, except as the northern galls may appear later in the summer and the insects may emerge earlier in the fall.

Cynips (Cynips) agama Hartig

agamic form

Figures 19, 85, 104, 120, 129

Cynips agama Hartig, 1840, Germar Ent. Zeit. 2: 188, 197, 198 (♀, ⊕). Hartig, 1843, Germar Ent. Zeit. 4: 406. Reinhard, 1865, Berliner Ent. Zeit. 9: 6. Schenck, 1865, Jahrb. Ver. Nassau 17-18: 175, 179, 223, 227, 250 (♀, ⊕). Taschenberg, 1866, Hymen. Deutschl. :144. Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 380. Kaltenbach, 1874, Pflanzenfeinde :665. Dalla Torre, 1898, Cat. Hymen. 5: 274.

Dryophanta agama Mayr, 1871, Mitteleurop. Eichen-gallen: 37, pl. 5 fig. 52 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 689, 710, 712. Mayr, 1874, Verh. zoo.-bot. Ges. Wien 24: 60, 80. Rudow, 1875, Arch. Naturg. Mecklenburg 29:32, 56. Mayr-Fitch, 1876, The Ent. 9: 147, 150, fig. 52. Wachtl, 1876: 19. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28: 319. Mayr-Fitch, 1878, The Ent. 11: 226. Uhlmann, 1880, Mitt. Schweiz. Ent. Ges. 1880: 30. Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 36 (♀). Hieronymus, 1890, Jahresb. Schlesisch. Ges. 68:exc. 167, 183 (⊕). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 32. Liebel, 1892, Ent. Nachr. 18: 275. Dalla Torre, 1892, Bericht. nat.-mediz. Ver. Innsbruck 1891-92: 147. Cameron, 1893, Brit. Phytoph. Hymen. 4: 10, 27, 67, 122, 126, pl. 2 fig. 2. Dalla Torre, 1893, Cat. Hymen. 2: 48. Riedel, 1896, Gallen und Gallwespen: 42, pl. 4 fig. 31, 31a. Dalla Torre, 1898, Cat. Hymen. 5: 176, 278, 283, 293, 326, 327, 342. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 3-8. Kieffer, 1901, André Hymén. Europe 7 (1): 124, 193, 626, pl. 18 fig. 2, 2a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 445. Darboux and Houard, 1901, Zoocécid. Europe: 341, fig. 643. Connold, 1902, Brit. Veget. Galls: 306. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 41. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Blösch, 1903, Mitt. Schweiz. Ent. Ges. 11: 48, 51. Kieffer, 1903, André Hymén. Europe 7 (2): 678. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 578. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55: 545. Darboux and Houard, 1907, Galles de Cynipides: 240, pl. 22, fig. 4, 5, 6 (not fig. 9, 10). Connold, 1908, Brit. Oak Galls: 12, 108, pl. 40. Schmidt, 1909, Zeit. Insektenbiol. 5: 50. Houard, 1908, Zoocécid. Europe 1: 254, (318, 320?), fig. 451-452. Bayer, 1908, Marcellia 7: 3-9, fig. 4. Mariani, 1908, Marcellia 7: 114. Houard, 1909, Marcellia 8: 70, fig. 10-14. Bayer, 1909, Verh. zoo.-bot. Ges. Wien 59: 119. Dittrich and Schmidt, 1909, Jahresber. Schlesisch. Ges. 1909: 102. Cotte, 1910,

Marcellia 8: 154. Riedel, 1910, Gallen und Gallwespen: 24, 45, 81, 90, 94, pl. 4 fig. 35, 35a. Bayer, 1910, Marcellia 9: 94, 100. Noury, 1911, Bull. Soc. Sci. Nat. Rouen 1911: 142. Küster, 1911, Gallen der Pflanzen: 389. Schulz, 1911, Festschr. Ver. Cassel 1911: 159. Dieroff, 1911, Bericht. ent. Vereins Lepid. 30: 39. Swanton, 1912, Brit. Plant-galls: 32, 171. Henriksen, 1914, Ent. Meddel. 10: 98. Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70:238, 289.

Cynips (Dryophanta) agama Kaltenbach, 1874, Pflanzenfeinde: 791. Karsch, 1883, Die Insektenwelt: 214.

Cécidie 73 Darboux and Houard, 1907, Galles de Cynipides: 241, pl. 22 fig. 4-6 (⊕) [NOT page 240, pl. 22 fig. 9, 10]. Brandza, 1914, Zoocecid. Romania: 48.

Diplolepis agama Dalla Torre and Kieffer, 1910, Das Tierreich 24: 343, 352, 624, 625, 783, 789, fig. 70, 71 (♀, ⊕). Houard, 1912, Marcellia 11: 110. Borcea, 1912, Zoocecid. România: 78. Cotte, 1912, Galles de Provence: 181, 194. Bayer, 1914, Moravské Hálky: 77. Kieffer, 1914, Schröder Ins. Mitteleuropas 3 (3): 31, 46, 63, 69, pl. 1 fig. 11, 12. Hedicke, 1915, Zeit. Insektenbiol. 11: 118. Ross, 1916, Pflanzengallen Bayerns: 67. Henrich, 1916, Verh. Siebenbürg. Ver. Hermannstadt 66: 103. Baudys, 1916, Verh. zoo.-bot. Ges. Wien 66: 81. Houard, 1919, Marcellia 16: 131. Houard, 1919, Marcellia 17: 12. Houard, 1922, Zoocécid. Afrique, etc. 1: 102, (133, 136?). Houard, 1922, Marcellia 18: 8. Houard, 1922, Marcellia 19: 51. Houard, 1922, Marcellia 19: 78. Baudys, 1925, Publ. Inst. Phytopath. Brno 39: 26, 28. Baudys, 1926, Bull. École Supér. Brno C 7: 38, 42. Baudys, 1926, Bull. École Supér. Brno C 8: 13. Jaap, 1927: 177, 178. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 229. Bischoff, 1927, Biol. Hymen.: 119. Tavares, 1928, Broteria 25: 46, pl. 3 fig. 23 (in part).

FEMALE.—The insect bright red rufous and rufo-piceous, the head hardly narrower than the rather slender thorax; the mesonotum in part punctate and hairy, with a fair sized smooth, naked, and shining area between and just lateral to the parapsidal grooves especially posteriorly; the anterior parallel and lateral lines not prominent; the mesopleuron with a naked spot and band which is larger than in *Cynips divisa divisa;* the abdomen not more than half again as long as high, with the second segment reaching not more than three-quarters of the way to the tip of the abdomen dorsally; the tip of the second abscissa of the radius hardly at all enlarged; length 2.0 to 3.2 mm., the insect distinctly smaller than *agama* or *disticha.* Figures 85, 104.

GALL.—Similar to those of *divisa* and *disticha,* spherical, ellipsoidal, or egg-shaped, more often ellipsoidal, not always regular, distorting a bit on drying; up to 4.0 mm. in its longest axis; the surface often irregularly set with blunt protruberances; at first light yellow or tinged with red, becoming light straw brown in color. The larval cell 3.0 mm. or more in length, occupying most of the gall, the spongy filling of the gall therefore much reduced, the cell barely distinct, wholly inseparable, sometimes connecting directly with the outer wall of the gall. Attached

to lateral veins, on the under surfaces of leaves of *Quercus pedunculata, Q. sessiliflora,* and *Q. pubescens.* Figures 120, 129.

RANGE.—England: Hastings (acc. Connold 1908).

Denmark: northern Bornholm (acc. Bayer 1909).

Belgium (Van Segvelt acc. Darboux and Houard 1907).

France: St. Saëns (Noury in Kinsey coll.). Héronchelles in Seine-Inf. (acc. Houard 1922). Bézu in Eure (Cornu acc. Houard 1922). Lorraine (Liebel acc. Riedel 1896). Near Paris (acc. Houard 1922). Monestier-de-Clermont in Isère (acc. Cotte 1910). Marseille-Sainte-Marguerite (acc. Cotte 1912). Saint-Martin-de-la-Brasque in Vaucluse (acc. Cotte 1912). La Motte-d'Aigues in Vaucluse (acc. Cotte 1912).

FIG. 19. VARIETIES OF CYNIPS AGAMA

Possible extensions of known ranges shown by shading.

Germany: Freiburg in Baden (Braun acc. Hieronymus 1890). Near Segeberg, Niendorf, and Mölln (acc. Jaap 1927). Nassau (acc. Schenck 1865). Bleicherode (P. Eigen in Kinsey coll.). Solingen (P. Eigen in Kinsey coll.). Berlin (in Kinsey coll.). Halle (acc. Schlechtendal 1870). Bavaria (acc. Ross 1916). Zwickau (acc. Schlechtendal 1870). Freiberg in Saxony (acc. Schlechtendal 1870). Gera (acc. Dieroff 1911). Dresden (in Kinsey coll.). Rinkenkuhl am Hirschberg (acc. Schultz 1911). Tharandt (Baer acc. Riedel 1910). Zobten (acc. Hieronymus 1890). Near Strehlen (acc. Hieronymus 1890). Jauer, Grünberg in Silesia, Naumberg a B., and Niesky (acc. Dittrich and Schmidt 1909). Sagan (Schmidt acc. Riedel 1910). Danzig (in M. C. Z.?). Nisky in der Lausitz (acc. Schlechtendal 1870).

Switzerland: Bern (acc. Uhlmann 1880). Laufenburg (acc. Blösch 1903). Zurich (Trotter acc. Tavares 1928).

Austria: Lower Austria (Mayr in Mus. Comp. Zool.). Ambrasser Park in Tyrol (Peyritsch acc. Dalla Torre 1892).

Czecho-Slovakia: northern Bohemia (in Kinsey coll.). Brandys nad Labem, Jicín, Rozdalovice, Sobotka, Hrdonovice, Msene, and Mnichovo Hradisté (acc. Bayer 1910). Königsall and Dawle (acc. Baudys 1916). Trest, Tisnov and Kurim (acc. Baudys 1925). Chlumec n. Cidl., Hradec Kralové, Jindr. Hradec, Tabor, Horazdovice, Prague, Ml. Boleslav, Butoves, Robousy, Popovic, Zeleznice, Trosky, Hodkovice n. Moh., Chotebor, Zbraslavi, Kopidlna, and Brno (all acc. Baudys 1926). Also see Bayer, 1914, Moravské Hálky: 77.

Italy: Valtellina (acc. Mariani 1908).

Hungary: near Budapest (Sajo in Kinsey coll.).

Rumania: Hermannstadt (acc. Henrich 1916). Putna (Paşcanilor, La Manastirea Neamtului and Vanatori (acc. Brandza 1914). Tulchea and Bakau (acc. Borcea 1912).

Apparently confined to more Central Europe, known from Hungary to southeastern France, England, and Denmark. Not known in the Mediterranean areas of Europe or Africa. The record for Asia Minor needs re-determination. Figure 19.

ORIGINAL DESCRIPTION.—Hartig, 1840, Germar Ent. Zeit. 2: 188. C. AGAMA m.: nigra; ore, orbitis oculorum, collare, thoracis dorso, scutello, pedibusque rufis, coxis femorumque basi plus minus nigris; thoracis dorso minus villoso quam in antecedentibus; alae nervis rufis. Long. 1½ lin.

Die Galle von der Grösse, Form und Farbe einer Erbse, etwas länger als breit und hoch, an der Basis eingedruckt; dadurch fast nierenförmig, einkammerig, auf den Blättern junger Eichen mitunter in sehr grosser Zahl.

Translation. Cynips agama, new species. Black; with the mouth, the area about the eyes, the pronotum, the mesonotum, the scutellum, and the legs rufous; the coxae and the bases of the femora more or less dark; the mesonotum less hairy than in *C. longiventris;* the wing veins reddish; the length 3 mm.

The gall the size, form, and color of a pea, somewhat longer than high and wide, narrower at the base, therefore almost kidney-shaped; monothalamous; on the leaves of the young oaks, at times in very great numbers.

TYPES.—Not designated and probably not in existence. Hartig's material from northern Germany.

The present descriptions are based on the published descriptions cited in the bibliography, and on material which I have from Germany, France, Hungary, Bohemia, (and Finland?), bearing determinations by P. Eigen, Forsius, Houard, Noury, and Sajo (as detailed in the distribution data).

INQUILINES.—*Synergus albipes* Hartig. Emerges in August of the same year (acc. Mayr 1872).

S. apicalis Hartig (Brischke 1882 acc. Kieffer 1901).

S. pallicornis Hartig (acc. Mayr 1872). Emerges from April to June in the following year (acc. Riedel 1896).

S. varius Hartig. Emerges in April in the following spring (acc. Dalla Torre and Kieffer 1910).

S. nigripes Hartig and *S. flavicornis* Hartig, described by Hartig 1840 as from *agama*, are considered synonymous with *S. pallicornis* by Dalla Torre and Kieffer 1910).

PARASITES.—*Decatoma biguttata* (Swederus) (Brischke 1882 acc. Dalla Torre 1898). Emerges the same fall or the following spring (acc. Mayr 1905).

D. variegata Walker (= *Eurytoma signata* Nees) (Brischke acc. Dalla Torre 1898).

Eupelmus bedeguaris Ratzeburg (Ratzeburg 1852 acc. Dalla Torre 1898).

E. urozonus Dalman (Hartig acc. Dalla Torre 1898).

Eurytoma aethiops Boheman (acc. Blösch 1903).

E. rosae Nees. Emerges from August to December of the same year (acc. Mayr 1878).

Habrocytus saxeseni Ratzeburg (Brischke 1882 acc. Kieffer 1899).

Mesopolobus fasciiventris Westwood (= *Pteromalus fasciculatus* Förster). (Brischke acc. Dalla Torre 1898).

Ormyrus punctiger Westwood (= *Siphonura brevicauda* Nees) (acc. Dalla Torre 1898). Emerges in September (acc. Mayr 1904).

Pteromalus fuscipalpus Förster (Reinhard 1856 acc. Kieffer 1899).

Syntomaspis cyanea (Boheman) (= *S. eurynotus* (Walker)) (acc. Mayr 1874).

S. druparum (Boheman) (= *Torymus pubescens* Förster) (Kaltenbach acc. Kieffer 1901).

Torymus abdominalis Boheman (Giraud 1877 acc. Kieffer 1899).

T. cyaneus (Walker) (acc. Blösch 1903).

T. cultriventris Ratzeburg (Brischke 1882 acc. Kieffer 1899).

T. nigricornis Boheman (= *T. regius* Nees) (acc. Mayr-Fitch 1876).

The galls of this species are not as well represented in the collections as the similar galls of *Cynips divisa*. *Agama* galls are to be distinguished by their smaller size, more uniformly ellipsoidal shape, and much thinner walls. The young galls appear in June (acc. Mayr 1872), becoming mature by the end of August (acc. Connold 1908) or early in September (acc. Kieffer 1901). The non-parasitized galls are deciduous (acc. Kieffer 1901). The adults emerge in October and November (acc. Schlechtendal 1870 and Mayr 1882), more often in November (acc. Kieffer 1901). Further data on the biology of the species are not available. The alternating bisexual insect is not recognized, but it may be expected to inhabit a small cell-like gall in the buds or on the leaves of

the oak. It is possible that both the adults and galls of this bisexual form will resemble *Cynips divisa* form *verrucosa.*

Küstenmacher has briefly described the histologic structure of the galls of agama (acc. Darboux and Houard 1907).

The insects of the Central European material of *agama* and *divisa* are even closer than their galls, *agama* differing primarily in its shorter abdomen, mesopleura with larger naked areas, and a second abscissa of the radius with a tip that is hardly enlarged.

As far as the records indicate, *agama* is as strangely absent from the Mediterranean area of Europe as *Cynips longiventris.* Tavares' record (1902, Ann. Sci. Nat. Porto 7: 49) of *agama* in Portugal probably applies to *Cynips divisa* (see Tavares 1902, Rev. Sci. Nat. S. Fiel 1: 115), and the record for Spain is open to question (see Tavares 1928: 48). I have galls (Forsius coll.) from Finland that certainly belong to this species; but the other Cynipidae from that region so often prove distinct that we shall wait insect material to determine whether another variety of *agama* is represented in more northern Europe.

In Darboux and Houard's publication (1907) of Giraud's Galles de Cynipides the plate (number 22, figs. 9, 10) bearing the legend *agama* obviously represents *Cynips disticha.* Bayer (1908) has also pointed this out, and Houard himself (1909), Marcellia (8:70) has agreed to this interpretation. Figures 4 to 6 on the same plate do represent *agama.*

I do not feel that the Réaumur references (Réaumur 1737, Mém Ins. 3: 416, 440, 445, 447, 448, pl. 35 figs. 3, 4) given by many European authors, including Dalla Torre (1893) and Kieffer (1901), may be interpreted with any certainty as one or the other of three closely related species, *Cynips divisa, C. agama,* and *C. disticha.*

Cynips (Cynips) disticha Hartig

agamic form

Figures 20, 86, 105, 123-124, 133-134

Cynips disticha Hartig, 1840, Germar Ent. Zeit. 2: 188 (♀, ⊕). [NOT Hartig, 1841, Germar Ent. Zeit. 3: 324]. Hartig, 1843, Germar Ent. Zeit. 4: 406. Reinhard, 1865, Berliner Ent. Zeit. 9: 6. Schenck, 1865, Jahrb. Ver. Nassau 17-18: 158, 176, 180, 223, 227, 250 (♀,

⊕). Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 381. Kaltenbach, 1874, Pflanzenfeinde: 667, 791. Sharp, 1895, Cambridge Nat. Hist. 5: 530.

Cynips distichus Hartig, 1840, Germar Ent. Zeit. 2: 198.

Cynips distigma Taschenberg, 1866, Hymen. Deutschl.: 144.

Dryophanta disticha Mayr, 1871, Mitteleurop. Eichen-gallen: 38, pl. 5 fig. 53 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 689, 712. Mayr, 1874, Verh. zoo.-bot. Ges. Wien 24: 60, 80, 97, 98. Rudow, 1875, Arch. Naturg. Mecklenburg 29: 33, 56. Mayr-Fitch, 1876, The Ent. 9: 171, fig. 53. Mayr, 1878, \ erh. zoo.-bot. Ges. Wien 28: 319. Mayr-Fitch, 1878, The Ent. 11: 226. Uhlmann, 1880, Mitt. Schweiz. Ent. Ges. 6: 30. Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 37 (♀). Schlechtendal, 1891, Jahresb. Ver. Zwickau 1890: 32. Liebel, 1892, Ent. Nachr. 18: 275. Cameron, 1893, Brit. Phytoph. Hymen. 4: 10, 27, 67, 122, 128, pl. 2 fig. 3 (♀). Dalla Torre, 1893, Cat. Hymen. 2: 49. Mosley, 1893, Ent. Month. Mag. 29: 194. Riedel, 1896, Gallen und Gallwespen: 43, pl. 4 fig. 32, 32a. Appel, 1898, Schriften Physikal.-ökon. Ges. 39: 96. Bignell, 1898, Ent. Month. Mag. 34: 275. Dalla Torre, 1898, Cat. Hymen. 5: 176, 283, 284, 293, 310, 326, 327, 342. Kieffer, 1901, André Hymén. Europe 7 (1): 124, 649, pl. 18 fig. 1, 1a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 446. Darboux and Houard, 1901, Zoocécid. Europe: 342, fig. 642. Connold, 1902, Brit. Veget. Galls: 306. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 41. Houard, 1902, Marcellia 1: 45, fig. 18, 19. Kieffer, 1903, André Hymén. Europe 7 (2): 680. Dalla Torre and Kieffer, 1903, Gen. Ins. Hymen. Cynip.: 52. Mayr, 1903, Verh. zoo.-bot. Ges. Wien 53: 391. Rössig, 1904, Von welchen Organen....: 11. Ross, 1904, Gallenbild. der Pflanzen: fig. 2 h. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 579. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55: 545. Gräffe, 1905, Boll. Soc. Nat. Triest 23: 31, pl. 2 fig. 1, 1a-c. Fortwaengler, 1907, Zeit. Insektenbiol. 3: 130. Connold, 1908, Brit. Oak Galls: 27, 110. Houard, 1908, Zoocécid. Europe 1: 256, fig. 449, 450, 457, 458. Bayer, 1908, Marcellia 7: 3-9, fig. 1-3. Mariani, 1908, Marcellia 7: 114. Houard, 1909, Marcellia 8: 71, figs. 15-17. Riedel, 1910, Gallen und Gallwespen: 24, 45, 81, 90, 94, pl. 4 fig. 34, 34a. Bayer, 1910, Marcellia 9: 100. Schulz, 1911, Festschr. Ver. Cassel 1911: 194. Noury, 1911, Bull. Soc. Sci. Nat. Rouen 1911: 143. Weidel, 1911, Flora (2) 2: 321-322, fig. 36-38. Küster, 1911, Die Gallen der Pflanzen: 169, 230, fig. 85a. Dieroff, 1911, Bericht ent. Vereins Lepid. 30: 39. Swanton, 1912, Brit. Plant-galls: 32, 171. Houard, 1919, Marcellia 16: 132. Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70: 238, 289.

Cynips (Dryophanta) disticha Karsch, 1883, Die Insektenwelt: 214.

Dryophanta agama err. det. Darboux and Houard, 1907, Galles de Cynipides: 240, pl. 22 fig. 9, 10 (⊕).

Diplolepis disticha Dalla Torre and Kieffer, 1910, Das Tierreich 24: 13, 344, 353, 623-625, 764, 783, 786, 789, fig. 74, 75. Cotte, 1912, Galles de Provence: 194. Houard, 1912, Marcellia 11: 34, 111. Kieffer,

1914, Schröder Ins. Mitteleuropas 3 (3): 45, 64, 69, 70. Bayer, 1914, Moravské Hálky: 77. Houard, 1914, Marcellia 13: 26. Hedicke, 1915, Sitz. Ges. naturf. Fr. Berlin 1915: 260. Hedicke, 1915, Zeit. Insektenbiol. 11: 23. Houard, 1915, Marcellia 14: 99. Baudys, 1916, Verh. zoo.-bot. Ges. Wien 66: 81. Ross, 1916, Pflanzengallen Bayerns: 67. Houard, 1919, Marcellia 17: 12. Houard, 1922, Marcellia 18: 9. Houard, 1922, Marcellia 19: 79. Baudys, 1925, Publ. Inst. Phytopath. Brno C39: 28. Baudys, 1926, Bull. École Supér. Brno C7: 42. Bischoff, 1927, Biol. Hymen.: 120, 489. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 229.

FEMALE.—The entire insect (except the terminal halves of the antennae) with only a bit of darker rufous; the head hardly narrower than the slender and distinctly elongate thorax; the mesonotum with a very few, scattered hairs and punctation, but in large part smooth, naked, and shining; the anterior parallel and lateral lines hardly visible; the mesopleuron largely hairy and punctate with a smooth band above the center; the abdomen nearly twice as long as high, the second segment extending only half or two-thirds of the way to the tip of the abdomen dorsally; the tip of the second abscissa of the radius only slightly enlarged; the length 2.6 to 3.7 mm., averaging smaller than *divisa* but larger than *agama*. Figures 86, 105.

GALL.—Similar to the gall of *divisa* but only superficially spherical, distinctly flattened at top and bottom and therefore more or less cylindrical with an impressed tip on top, not strictly regular in shape; not much distorted on drying; up to 5.0 mm. in longest axis; largely smooth and naked, occasionally with a few irregularities on the surface; becoming a bright, more or less rosy brown in color. The thin outer shell with a distinct hardened (collenchyma) layer beneath, with some spongy parenchyma; much of the interior of the gall occupied by two cavities, the larger of which, located above, is an open chamber, while the larval cell is located below; the larval cell averaging 2.5 mm. in length, with a distinct cell wall which is inseparable on all sides except where it lies toward the open chamber of the gall. Attached to the veins on the leaves of *Quercus pedunculata, Q. sessiliflora,* and *Q. pubescens.* Records for other oaks may apply to distinct varieties. Figures 123-124, 133-134.

RANGE.—England: Southern part (acc. Connold 1908). Huddersfield (acc. Mosley 1893). Saltash, St. Issey in Cornwall, Cann Woods, and Bickleigh Woods (acc. Bignell 1898).

France: Normandy (acc. Noury 1911). Alençon (acc. Houard 1915). Montargis (Leone acc. Houard 1914). Mezilles (acc. Houard 1902). Druyes in Yonne (acc. Houard 1922). Lorraine (acc. Kieffer 1901). Pertuis, La Motte-d'Aigues in Vaucluse, and Peypin-d'Aigues in Vaucluse (acc. Cotte 1912). Digne (Daumézon acc. Cotte 1912).

Switzerland: Bern (acc. Uhlmann 1880).

Germany: northern part (acc. Hartig 1840). Mark Brandenburg (acc. Hedicke 1915). Nassau (acc. Schenck 1865). Ruhla, and Wit-

tenberg in Saxony (acc. Weidel 1911). Bleicherode (P. Eigen in Kinsey coll.). Halle (acc. Schlechtendal 1870). Freiburg i. B. (acc. Rössig 1904). Zwickau (acc. Schlechtendal 1870). Buchow (Schirmer in Kinsey coll.). Gera (acc. Dieroff 1911). Bavaria (acc. Ross 1916). Bautzen (near Dresden, and Berggiesshübel (acc. Riedel 1910).

Austria: Vienna (Mayr in Kinsey coll.). Bozen (acc. Mayr 1882). Northern Tyrol (acc. Fortwaengler 1907).

Czecho-Slovakia: Brandys nad Labem, Jicín, Tábor, Konecchlum, and Loreta (acc. Bayer 1910). Brno (acc. Baudys 1925). Kopidlna and Zeleznice (acc. Baudys 1926). Near Prague (acc. Baudys 1916). Also see Bayer, 1914, Moravské Hálky: 77.

Hungary (Paszlavszky acc. Kieffer 1901).

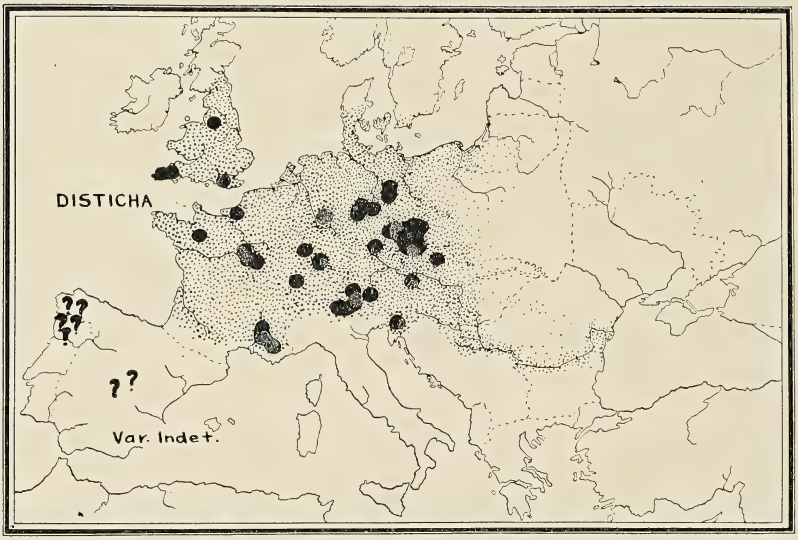


FIG. 20. VARIETIES OF CYNIPS DISTICHA

Possible extension of known range shown by shading.

Italy: Triest (acc. Gräffe 1905; also in Kinsey coll.). Valtellina (acc. Mariani 1908). Southern Tyrol (acc. Mayr 1878).

Known thruout Central Europe, from Hungary and southern France to England and northern Germany. It is probably a distinct variety that is recorded for Spain and Portugal. Figure 20.

ORIGINAL DESCRIPTION.—Hartig, 1840, Germar Ent. Zeit. 2: 188. C. disticha m.: rufa; antennis obscure-fuscis; strigis dorsalibus mesothoracis, basi coxarum femorumque, metathoracis declivitate, dorsoque abdominis plus minus nigris. Long. 1¼-1½ lin.

Die Galle von der Grösse, Form und Farbe einer Erbse, nach oben kegelförmig etwas verengt, in der Mitte der Oberfläche eingedrückt, mit kleinem Nabel. Die innere Höhlung ist durch eine horizontale Scheidewand in zwei Kammern getheilt, von denen jedoch nur eine bewohnt wird.

Translation. Cynips disticha new species: rufous, the antennae dark brown; with the grooves of the mesonotum, the bases of the coxae and the femora, the sides of the metathorax, and the dorsal surfaces of the abdomen more or less black; length 2.5 to 3.0 mm.

The gall of the size, form, and color of a pea, somewhat constricted cone-shaped above, distinctly constricted in the middle, with a small navel. The inner cavity of the gall is divided by a horizontal partition into two chambers, only one of which, however, is inhabited.

TYPES.—Not designated and probably not in existence. Hartig's material from northern Germany.

The present descriptions are based on the published descriptions cited in the bibliography, and on material in my collection from Germany, Italy (Triest), and Austria, determined by P. Eigen and G. Mayr (as detailed in the distribution data above).

INQUILINES.—*Synergus albipes* Hartig. Emerges in August of the same year (acc. Mayr 1872).

S. pallicornis Hartig (acc. Mayr 1872). Emerges the following April.

S. thaumacerus Dalman (Brischke 1882 acc. Kieffer 1901).

S. tscheki Mayr. Emerges in March and April of the following spring (acc. Dalla Torre and Kieffer 1910).

S. vulgaris Hartig (acc. Hartig 1840). Emerges from March to May in the following spring (acc. Dalla Torre and Kieffer 1910).

PARASITES.—*Decatoma biguttata* (Swederus) (= *Eurytoma signata* Nees). (Brischke acc. Dalla Torre 1898). Emerges the following spring (acc. Mayr 1905).

D. variegata Walker (acc. Dalla Torre 1898).

Eupelmus urozonus Dalman (acc. Ruschka 1920).

Eurytoma rosae Nees. Emerges from October of the same year into the following spring (acc. Mayr 1878).

E. setigera Mayr. Emerges the following year from January to May (acc. Mayr 1878).

Habrocytus saxeseni Ratzeburg (acc. Kieffer 1901).

Mesopolobus fasciiventris Westwood (Brischke 1882 acc. Dalla Torre 1898).

Olinx gallarum (Linnaeus) (Brischke 1882 acc. Kieffer 1899).

Ormyrus punctiger Westwood (= *Siphonura brevicauda* Nees) (Brischke 1882 acc. Dalla Torre 1898). Emerges from May to July in the following year (acc. Mayr 1904).

O. schmidtii (Nees) (Hartig acc. Dalla Torre 1898).

O. variolosus (Nees) (Brischke acc. Dalla Torre 1898).

Syntomaspis cyanea (Boheman) (acc. Mayr 1874).

S. sapphyrina (Boheman) (= *S. caudata* (Nees)) (Brischke 1882 acc. Kieffer 1901).

Torymus abbreviatus Boheman (Giraud 1877 acc. Kieffer 1899).

T. abdominalis Boheman (acc. Kieffer 1901).

T. auratus (Fourcroy) (Brischke 1882 acc. Kieffer 1899).

T. nigricornis Boheman (= *T. regius* Nees). Emerges in March and May of the following year (acc. Mayr 1874).

Cynips disticha seems poorly represented as far as the number of specimens in the collections is concerned, altho it is known from a goodly number of localities in Central Europe. Hartig's report of its abundance in his region in Germany in 1840 was later corrected to apply to *Cynips divisa* (Hartig, 1843, Germar Ent. Zeit. 4:398). *Disticha* remains, then, as the most poorly-known *Cynips* of Central Europe.

The young galls of *disticha* appear early in the summer, probably earlier than Schlechtendal's records (1870) for early July, reaching maturity by the end of August (acc. Connold 1908) or in September (acc. Kieffer 1901). The insects are mature by October, usually delaying emergence until later in October or in November. Bignell (1898) did breed adults on October 1 and 3 in Cornwall. Schlechtendal (1870) gives October and November for the emergence in southeastern Germany, Cotte (1912) says the same for Provence, and Mayr's dates (1882) agree for Austria. Kieffer (1901) found November emergence in Lorraine. Schenck (1865: 227) gave the following spring as the time of emergence for *disticha*, but, considering the other records for this insect and the biology of the genus as a whole, Schenck's records must certainly be an error or an instance of abnormal factors delaying normal emergence.

There seem to be no further data on the biology of *disticha*, the alternating bisexual form being unrecognized. This spring generation may prove to be similar to the bisexual generations of the other species of European *Cynips*.

The known range of *disticha* parallels the ranges of other Central European *Cynips*, except for the absence of records north of more Central Germany. Perhaps this deficiency will be filled in by further collecting. The species is poorly represented in the collections from Mediterranean Europe, even being absent from the coast of Provence in France. There are several records for the Iberian peninsula, which, considering the localities and the distinct hosts represented, may apply to distinct varieties. This question can be settled only from good series of insects from the region. The published records for this material are as follows:

Dryophanta disticha Kieffer, 1901, André Hymén. Europe 7 (1): 85, 100, 639, pl. 21 fig. 19, 19a (records for Spain and Portugal, on *Q. coccifera, Q. lusitanica, Q. faginea, Q. ilex, Q. suber* only). Darboux and Houard, 1901, Zoocécid Europe: 294, 308. Darboux and Houard, 1902, Zoocécid. Hilfsbuch: 38, 40. Tavares, 1902, Rev. Sci. Nat. S. Fiel 1: 115 (Portugal). Houard, 1908, Zoocécid. Europe 1: 285, 298, 313, 354.

Diplolepis disticha Dalla Torre and Kieffer, 1910, Das Tierreich 24: 778, 780, 781, 790 (incl. *Q. mirbecki*). Hedicke, 1915, Sitz. Ges. naturf. Fr. Berlin 1915: 260 (*Q. lanuginosa Hentzei* and *Q. lusitanica* in Dahlemer Bot. Gartens). Tavares, 1928, Broteria 25: 24, fig. 36, pl. 3 fig. 6, 8, 9 (records for Portugal and Spain, on *Q. Robur, Q. pedunculata,* and *Q. lusitanica*).

Weidel (1911) gives a detailed account of the histology of the gall of *disticha,* stating that Lacaze-Duthiers (1853) and Küstenmacher (1894) had also studied this gall structure. In my own analysis of Lacaze-Duthiers' paper I question whether precise determinations may be made of the material with which this early author worked.

In Darboux and Houard's publication (1907) of Giraud's Galles de Cynipides, figures 9 and 10 on plate 22 are good illustrations of galls of *disticha,* altho they were erroneously labelled *Cynips agama.* Bayer (1908) has pointed out this error and Houard (1908) has confirmed this interpretation.

I suggest that the Réaumur references (Réaumur 1737, Mém. Ins. 3: 416, 440, 445, 447, 448, pl. 35 figs. 3, 4) given by several European authors are not interpretable with any certainty as *Cynips divisa, C. agama,* or *C. disticha.*

Cynips (Cynips) cornifex (Kollar) Hartig

agamic form

Figures 21, 87, 106, 119, 138, 139

Cynips carnifex (laps!) Kollar in Hartig, 1843, Germar Ent. Zeit. 4: 406 (♀, ⊕). Taschenberg, 1866, Hymen. Deutschl. :144.

Dryophanta cornifex Mayr, 1871, Mittleurop. Eichen-gallen: 38, pl. 5 fig. 54 (⊕). Mayr, 1872, Verh. zoo.-bot. Ges. Wien 22: 689, 710. Mayr-Fitch, 1876, The Ent. 9: 172, fig. 54. Mayr, 1878, Verh. zoo.-bot. Ges. Wien 28:319. Mayr, 1881, Gen. gallenbew. Cynip.: 36. Mayr, 1882, Europ. gallenbew. Cynip.: 36 (♀). Wachtl, 1886, Wiener Ent. Zeit. 5: 307. Schlechtendal, 1890, Jahresb. Ver. Zwickau 1890: 33. Massalongo, 1892, Atti Congresso bot. Internaz. 1892: 31. Massalongo, 1893, Galle nella Flora Italica: 194, pl. 30 fig. 7. Camer-

on, 1893, Brit. Phytoph. Hymen. 4: 67, 121. Riley, 1895, Science n.s. 1: 463. Dalla Torre, 1898, Cat. Hymen. 5: 283, 294, 342. Kieffer, 1899, Ill. Zeit. Ent. 4: exc. 4, 5, 8. Kieffer, 1901, André Hymén. Europe 7 (1): 122, 636, pl. 24 fig. 4, 4a (♀, ⊕). Kieffer, 1901, Ann. Soc. Ent. France 1901: 443. Darboux and Houard, 1901, Zoocécid. Europe: 344, fig. 621. Darboux and Houard, 1902, Zoocecid. Hilfsbuch: 41. Houard, 1902, Marcellia 1: 45. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Kieffer, 1903, André Hymén. Europe 7 (2): 679. Mayr, 1903, Verh. zoo.-bot. Ges. Wien 53: 397. Mayr, 1904, Verh. zoo.-bot. Ges. Wien 54: 578. Trotter and Cecconi, 1904, Marcellia 3: 80. Mayr, 1905, Verh. zoo.-bot. Ges. Wien 55: 538. Gräffe, 1905, Boll. Soc. Nat. Triest 23: 32, pl. 2 fig. 4. Cobelli, 1905, Verh. zoo.-bot. Ges. Wien 55: 599. Massalongo acc. Mantero, 1906, Ann. Mus. Nat. Genova (3) 2: 447, 463. Darboux and Houard, 1907, Galles de Cynipides :246, pl. 16 fig. 1 (⊕). Connold, 1908, Brit. Oak Galls: 157. Houard, 1908, Zoocécid. Europe 1: 258, 313, fig. 424. Houard, 1909, Marcellia 8: 71. Ruschka, 1920, Verh. zoo.-bot. Ges. Wien 70: 238, 285, 289.

Cynips cornifex Kaltenbach, 1874, Pflanzenfeinde :669, 792.

Dryophanta carnifex Dalla Torre, 1893, Cat. Hymen. 2: 48. Riedel, 1896, Gallen und Gallwespen: 43.

Diplolepis cornifex Dalla Torre and Kieffer, 1910, Das Tierreich 24: 344, 353, 624, 762, 779, 783, 786, fig. 72, 73 A (♀, ⊕). Cotte, 1912, Galles de Provence: XLVI, 196. Houard, 1912, Marcellia 11: 33, 111. Houard, 1914, Marcellia 13: 26. Houard, 1919, Marcellia 16: 130. Houard, 1919, Marcellia 17: 11. Houard, 1922, Zoocécid. Afrique 1: 119. Houard, 1922, Marcellia 19: 79. Ross and Hedicke, 1927, Pflanzengallen Mit.- und Nordeuropas: 230. Tavares, 1928, Broteria 25: 49, fig. 43, pl. 3 fig. 17.

FEMALE.—The insect largely brownish rufous with a little piceous to black; the head almost as wide as the rather slender thorax; the mesonotum largely smooth, shining, and naked, very scantily hairy anteriorly and laterally; the anterior parallel and lateral lines barely indicated; the mesopleuron punctate and hairy with a large, smooth and naked area above the center; the abdomen nearly twice as long as high, strongly produced, but the tip of the second segment reaching not more than two-thirds of the way to the tip of the abdomen; the tip of the second abscissa of the radius neither bent nor enlarged; the length 1.8 to 3.0 mm. Figures 87, 106.

GALL.—A separable, horn-shaped, or stout club-shaped, reddish cone, attached to the under surfaces of a leaf. The cone long, slender, up to 20. mm. in length and 2.0 mm. in diameter, with the low base expanding to 3.0 mm. in diameter; the cone not wholly regular, more or less curved toward the tip, occasionally twisted more than 90°; the surface smooth, shining, and naked; green when fresh, becoming yellow brown or often reddish brown. The outer shell rather thin; internally with some compact, spongy fibers, but most of the interior taken up by an inseparable, elongate larval cell which may be up to 3.5 mm. in

length, and which is located near the base of the gall; the upper part of the cone with another irregular cavity, a small amount of the compact, spongy fibers separating this from the larval cell. The galls entirely separable, attached to veins on the under surfaces of leaves, rarely to the bark of young or old twigs (acc. Kieffer 1901), almost always on *Quercus pubescens* (= *Q. sessiliflora pubescens* of Trotter). Less often on *Q. lusitanica* (Trotter acc. Houard 1908) and *Q. pedunculata* (acc. Misciatelli 1895). Figures 119, 138-139.

RANGE.—France: Marseille (A. Vayssière acc. Houard 1914: 26). Nîmes (Darboux acc. Houard 1902). Pertuis, Motte-d'Aigues, Saint-Martin-de-la-Brasque, La Môle, Cogolin, and Sainte-Hélène near Nice (acc. Cotte 1912). Dourbes (Daumézon acc. Cotte 1912).

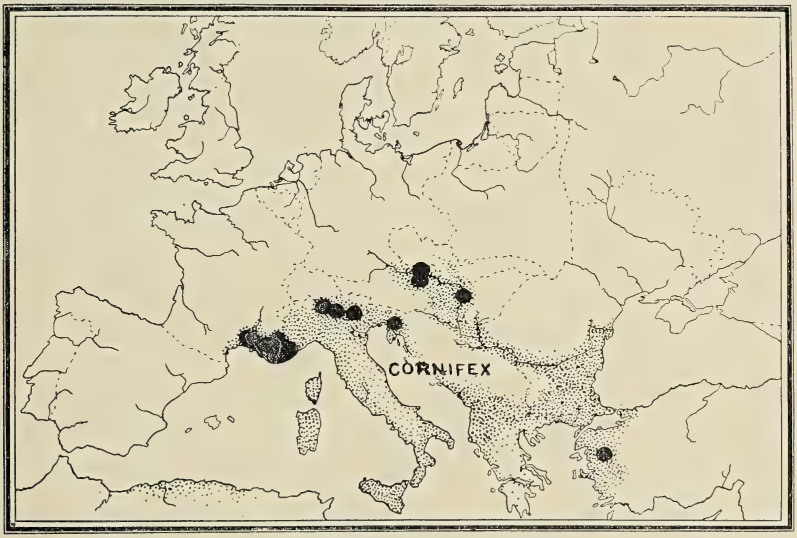


FIG. 21. CYNIPS CORNIFEX
Possible extension of known range shown by shading.

Italy: Tregnago (acc. Massalongo 1892). Verona (Trotter in Kinsey coll.). Triest (acc. Gräffe 1905). Brescia (Massalonga acc. Mantero 1906). Trentino (acc. Cobelli 1905).

Austria: Vienna (Kollar acc. Hartig 1843; et al. authors; also in Kinsey coll. and in U.S. Nat. Mus.).

Hungary (Paszlavszky acc. Kieffer 1901).

Asia Minor (Trotter acc. Houard 1908).

Distinctly Mediterranean, known from Asia Minor to Austria, northern Italy, and southern France. To be looked for elsewhere in southern Europe and perhaps in northern Africa. Figure 21.

ORIGINAL DESCRIPTION.—Hartig, 1843, Germar Ent. Zeit. 4: 406. C. carnifex *Kollar:* nigra, thoracis dorso nigromaculato pedibusque rufis; coxis tarsisque posterioribus nigris. Long. 1 lin.

Die Wespe bewohnt eine Blattgalle auf Quercus pubescens, und ist eine Entdeckung des Herrn *Kollar* in der Umgegend Wiens. Die Galle sitzt, wie alle Blattgallen auf der Unterseite des Blattes einer Blattrippe auf und besteht aus einem glatten, harten, drei Linien langen und ½-¾ Linien dicken, in der Mitte verengten, an der Spitze keulenförmig etwas erweiterten, mitunter etwas gekrümmten Hörnchen.

Translation. Cynips carnifex Kollar: black, with the mesonotum spotted black and the legs rufous; the coxae and the posterior tarsi black; length 2 mm.

The wasp lives in a leaf gall on *Quercus pubescens*, being a discovery of Kollar's in the neighborhood of Vienna. Like all leaf galls on the underside of the leaf, the gall is attached to a leaf vein; it is a smooth and hard horn, 6 mm. long and 1 to 1.5 mm. in diameter, constricted in the middle, with the tip club-shaped but somewhat swollen, the gall sometimes crumpled.

TYPES.—Not designated and probably not in existence. Originally described from material collected by Kollar in the neighborhood of Vienna, Austria.

The present descriptions are based on the published descriptions cited in the bibliography, on four adults from the Mayr collection (and Mayr det.) in the U.S. National Museum, and on galls from Austria and Italy in the Kinsey collection.

INQUILINE.—*Synergus pallicornis* Hartig (acc. Mayr 1872). Emerges in April of the following or the second following year (acc. Dalla Torre and Kieffer 1910).

PARASITES.—*Decatoma biguttata* (Swederus). Emerges in the fall and winter of the same year and the following spring.

D. variegata Walker (acc. Mayr 1905).

Eupelmus bedeguaris Ratzeburg (Giraud 1877 acc. Kieffer 1899: 4).

E. spongipartus Förster (acc. Ruschka 1920).

E. urozonus Dalman (acc. Ruschka 1920).

Eurytoma rosae Nees. Emerges the same fall and into the following June (acc. Mayr 1878).

Ormyrus punctiger Westwood (Rondani acc. Dalla Torre 1898). Emerges in December of the first year, and from May to July in the following year (acc. Mayr 1904).

Pteromalus incrassatus Ratzeburg (acc. Mayr 1903). Emerges in January and February of the following year.

Syntomaspis lazulina Förster (acc. Wachtl 1886).

Torymus abdominalis Boheman (Giraud 1877 acc. Kieffer 1899).

The beautiful, slender, conical, green or reddish-brown gall of this species is a unique departure from the more or less strictly spherical galls of the other species of European *Cynips*. Internally the gall shows some of the compact, spongy fibers which occur in the galls of nearly all species of

this genus, but on the basis of the gall alone this species should belong to the American Pacific Coast subgenus *Antron.* The insect is, nevertheless, typical of European *Cynips* and so close to the *divisa-agama-disticha* group of insects that it would be difficult to distinguish *cornifex* adults without the galls.

Cornifex is poorly represented in the literature and, as far as I can judge, in the European collections, only 17 locality records having accumulated in the 85 years that have elapsed since Hartig first described the species. The known range of *cornifex* closely parallels that of *flosculi,* the Mediterranean variety of *Cynips folii.* Whether *cornifex* will ultimately be found in the Spanish peninsula and in northern Africa, or whether it has Asiatic affinities which may account for a restricted range in Mediterranean Europe as well as the peculiar form of the gall, are data which we will await with interest.

The young galls of *cornifex* appear in June, and the insects are mature by September (acc. Kieffer 1901). Mayr (1882) recorded emergence in November and December. Biologic data beyond this seem to be lacking. The distinct character of the agamic gall even introduces some doubt whether the alternating, bisexual form will prove to be of the type so uniform among the other species of this subgenus. Riley (1895) is, of course, in error in suggesting that *Syntomaspis lazulina* (which is a chalcidid) is the bisexual form of our present cynipid!

Massalongo (acc. Darboux and Houard 1907) has published notes on the histologic structure of these galls.

Hartig originally published this species as of Kollar's manuscript. Since Kollar never published the description elsewhere, Hartig has usually been considered the author of the species, tho it might well be contended that he intended to name Kollar as author. Hartig's original spelling, *carnifex,* meaning hangman or executioner, can surely be proved to be a *lapsus* for *cornifex,* meaning horn bearer. Under Article 19 of the International Rules we seem to find an opportunity to be legal as well as reasonable and to write *cornifex* as practically all other authors have written it.

Cynips subgenus **Antron**, new subgenus bisexual and agamic forms

Dryophanta Mayr, 1902 (in part), Verh. zoo.-bot. Ges. Wien 52: 290. Beutenmüller, 1911 (in part), Bull. Amer. Mus. Nat. Hist. 30: 347-355. McCracken and Egbert, 1922 (in part), Stanford Univ. Publ. 3 (1): 11-13. Also of other authors.

Diplolepis Dalla Torre and Kieffer, 1910 (in part), Das Tierreich 24: 368, 369. Fullaway, 1911 (in part), Ann. Ent. Soc. Amer. 4: 337-338.

Holcaspis of some assignments of authors.

Disholcaspis of some assignments of authors.

Cynips of a few assignments of authors.

Andricus of a few assignments of authors.

Xanthoteras of one assignment: Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 52.

Acraspis of three assignments (Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 59-60).

FEMALE.—The cheeks moderately enlarged behind the eyes (agamic forms) or the eyes protruding beyond the cheeks (bisexual forms); antennae of moderate length, with 14 distinct segments; the thorax of moderate size; parapsidal grooves continuous (long-winged varieties) or discontinuous (short-winged varieties); median groove lacking; mesopleuron mostly smooth with scattered punctation (long-winged forms) or closely punctate and hairy (short-winged forms); abdomen smooth and naked except for the hairs latero-basally; hypopygial spine rather broad, somewhat drawn out at the ventral tip but this tip not as long as in *Acraspis;* tarsal claws of moderate weight, distinctly toothed; wings long, about 1.60 times (agamic forms) or 1.30 times (bisexual forms) the body in length, or much reduced and 0.36 to 0.8 of the body in length; if the wings are long the second abscissa is curved toward the tip but does not show such an angle as is found in *Acraspis,* the vein ends in an angulated expansion, the radial cell is moderately long and moderately broad and clear of spots or blotches; the areolet is of moderate size or smaller; the cubital cell has a large, smoky blotch basally and is either clear or spotted apically; and the discoidal cell has a single blotch basally (which is faint in several forms); if the wings are short, the venation is more or less reduced, most so in the shortest wings; moderate-sized insects 1.2 to 3.5 mm. in length.

MALE.—Differing from the bisexual female as described for the genus; with 15 antennal segments; with the coxae and the bases of the femora darker than the rest of the legs; the smoky patches and spots in the wings much lighter than in the female.

GALL.—Irregularly spherical; or squash-shaped with short, blunt, projecting tips; or elongate club-shaped; or cylindrical bowl-shaped, or flattened and disk-like; of moderate size; always smooth and naked or

at most microscopically puberulent or pubescent; the gall thick-walled, compact crystalline, with a more or less central cavity that is without a distinct larval cell (bisexual forms) or with a distinct larval cell (agamic forms) that is more or less closely imbedded and therefore only more or less separable. Attached singly, never in actual clusters; the agamic galls on the veins on the upper or under surfaces of the leaves; the bisexual galls are bud galls on the young twigs; on all the Pacific Coast white oaks including the *chrysolepis* group.

RANGE.—On the Pacific Coast of North America the group is known from Oregon and California and is probably to be found from British Columbia into Lower California; also known from southernmost Arizona. Figure 22.

SUBGENOTYPE.—*Cynips echinus* variety *schulthessae* form *schulthessae,* new variety, new form. Present designation.

FIG. 22. KNOWN RANGE, SUBGENUS ANTRON
Shading and figures indicate number of species known from each area.

This is a Pacific Coast subgenus known from three species, *echinus, teres,* and *guadaloupensis,* representing in all twelve described varieties. The group probably originated in our Southwest, entering California by the eastern Sierras perhaps in the Miocene (see pp. 68 to 71). Only *teres* of this subgenus extends into the Vancouveran Zone in Oregon (and possibly further north). *Teres* also differs somewhat from the other two species in its hypopygial spine and the form of its gall, and from *echinus* in having spotted wings. Never-

theless, the disadvantages of monotypic genera have led me to place *teres* in *Antron* until the discovery of additional species may encourage a more detailed classification.

The well-known agamic forms of four of the varieties of the species *echinus* are here united with the more recently discovered bisexual forms on admittedly circumstantial but considerable evidence. This is only the second set of life histories published for the Pacific Coast Cynipidae. Less certain is the suggested alternation of *teres* and Beutenmüller's *pulchella*. We have not recognized the bisexual form of any variety of *guadaloupensis*.

Two of the varieties of *teres* are short-winged insects that offer convincing evidence of the very close relations that may exist between long-winged and nearly wingless Cynipidae. All three of the known varieties of *guadaloupensis* have shortened wings, altho the reduction is not as great as in *teres*. The wing mutations have undoubtedly occurred independently in the two species.

Cynips (Antron) echinus Osten Sacken

bisexual and agamic forms

AGAMIC FEMALE.—Head slightly narrower than the thorax, thorax of normal size, dark rufous, piceous to black in places; mesonotum finely shagreened and punctate; parapsidal grooves of moderate width, distinct and continuous; anterior parallel lines in part smooth; lateral lines not wide but distinct and long; scutellum dark rufous, rather finely rugose; abdomen dark rufous, in part piceous to entirely black; legs entirely rufous or darker; wings always long; the cubital cell with a rather large, smoky-brown patch near its base but without additional spotting; the discoidal cell with less definite patches or almost clear; length 1.5 to 3.5 mm.

BISEXUAL FEMALE.—Head, thorax, and abdomen entirely black and piceous black, the antennae rich brown, in some varieties bright rufous yellow basally, the legs including all but the hind coxae bright rufous yellow; mesonotum entirely, prominently shagreened, nearly naked; anterior parallel lines entirely shagreened, hardly discernible; the lateral lines not smooth but more evident; scutellum more or less rugose; the mesopleura more nearly naked, smooth and shining; wings long, the cubital cell with an evident but not heavy, smoky patch near the base; the discoidal cell practically clear; length about that of the agamic female.

MALE.—As described for the subgenus *Antron*.

GALL OF AGAMIC FORMS.—Spherical to squash-shaped, hard and crystalline leaf galls, in most varieties bearing short and blunt projecting tips. Strictly or irregularly spherical, or a regular or irregular, inverted, truncate cone; up to 9.0 mm. in diameter, in most varieties bearing short, stout, often crooked and irregular, spiny projections which are in length not half the diameter of the body of the gall; the surfaces of the galls naked or with a puberulence, whitish or light green or pinkish when young, soon becoming (in most varieties) rose violet to coral red in color; internally filled with a compact mass of crystalline material containing a very few branched fibers, the galls soft as rubber when moist, hard and brittle as glass when dry; a more or less complete cavity in the center of the gall below the larval cell and near the very base of the gall, this cavity with the larval cell making the gall appear, superficially, bi-thalamous; the larval cell inseparable, embedded in the compact material of the gall or rarely (particularly in immature galls) held in place by fine, silky, radiating fibers; irregular in shape, up to 4.0 mm. in length, sometimes central in the gall, usually in the upper part of the gall directly under the epidermis, the cell centrally or asymmetrically placed, sometimes extending in part into one of the spiny projections. The gall wholly separable, attached by a point to a vein, usually on the under surfaces, sometimes on the upper surfaces of leaves of Pacific Coast white oaks, *Quercus lobata, Q. douglasii, Q. dumosa, Q. turbinella,* and *Q. durata.*

GALL OF BISEXUAL FORMS.—Spherical, berry-like, very succulent, pale green and more or less translucent when fresh, bright red when very young; the surface smooth or, in some varieties, pebbled and indefinitely marked with low ridges which bear soft, projecting points. The galls 4 to 7 mm. in diameter, shrivelling greatly upon drying, then becoming blackened; when dried upon the twig they become more or less obconical in shape, remaining lighter straw-brown in color. The wall of the gall moderately thin, thinnest apically; entirely hollow inside, without a distinct larval cell. Attached very insecurely by a single, slightly elongated point, on the twigs (bud galls) of probably all the oaks on which the agamic generation occurs; definitely known from only *Quercus lobata, Q. Douglasii,* and *Q. durata.*

RANGE.—California, Shasta County to the Mexican border, probably in Lower California.

There are few cynipid galls more abundant than those produced by the agamic forms of *echinus* in the autumn in California. These galls are confined to white oaks, and do not occur north of Shasta County.

The bisexual forms of *echinus,* on the other hand, are known from hardly more than a half dozen recent collections, representing, however, four of the six known varieties of the species. These bisexual galls are probably not rare, but they are

small, inconspicuously green in color, and so ephemeral that the chances of their collection are much reduced. They are bud galls that appear with the bursting of the leaf buds the first thing in the spring; they reach full size within a few days, and are then so loosely attached to the young, developing stems that they fall to the ground in a heavy wind or at the slightest touch. The larval insects reach full size rapidly and, transforming into adults, emerge within perhaps three weeks after the galls first appear. Emergence thus varies with the season, latitude, and altitude, the limits of our scant records being March 23 further south (at Three Rivers for form *ribes*) to May 13 further north (at Kelseyville for form *atrata*). Most of the emergence is probably in April. The males are not rare in our collections and they are probably produced in equal abundance with the females. Oviposition has not been observed, but it must be in the veins of the then young but unfolded leaves, for the agamic galls appear within a month and a half to two months of that time. The bisexual galls shrivel very greatly when collected and dried, and decay very rapidly when moist, the latter being the explanation of our complete failure to find them except in the short season before the maturity of the insect.

The young galls of the agamic forms first appear, at least north of the Sierra Madre, early in the summer; the larvae are mature within a couple of months, and the adults mature at various times from then on, emergence occurring in December or January. It should be noted that in mid-winter, in most of the areas involved, freezing temperatures are rare (varieties *echinus* and *douglasii*), while the colder days and snow storms of other parts of the region are intermingled with warm days when emerging insects might easily become active.

The insects and the galls of the bisexual and agamic forms here described have not hitherto been recognized as successive generations, for they are superficially quite distinct. They are not yet connected by the experimental data to which our conclusions must always be subject; but a closer examination shows so many points of similarity and so much confirmatory host, distribution, and life history data that we may be justified in our present interpretation.

In the first place, the bisexual insects clearly belong to the genus *Cynips* and to the subgenus *Antron*.

They differ no more from the agamic forms than the bisexual forms of European *Cynips* differ from their experimentally connected agamic forms.

There are only three species recognized among the agamic forms of *Antron,* and the present bisexual forms appear to be connected with the agamic *echinus* rather than with *teres* or *guadaloupensis,* for the following reasons: They have the mesonotum reticulated; they have blotched but not spotted wings; there is another bisexual insect (Beutenmüller's *pulchella*) which shows the spotted wings of the agamic *teres.*

The present bisexual forms are represented by varieties on *Q. lobata, Q. Douglasii,* and *Q. dumosa,* on all of which hosts we find the agamic *echinus* but not *teres* or *guadaloupensis; teres* is unknown from *Q. Douglasii* on which the agamic *echinus* is common.

The bisexual form is represented in the Central Valleys of California, an area in which *echinus* is common but *teres* unknown.

The bisexual galls are similar to the galls of the agamic *echinus* in being fundamentally spherical with short, blunt, projections; and the bisexual gall is most nearly spherical and most nearly spineless on the host that bears the agamic *echinus* galls of this nature (variety *schulthessae* on *Q. durata*).

There is nothing in the structural, host, and distributional data which would preclude the connection of these bisexual forms with *echinus,* while there would be the several inconsistencies noted above in connecting the forms with *teres.*

In spite of the difficulty of collecting the spring galls, they are known to represent four varieties and therefore probably belong to a species that has at least as many common agamic forms known. The agamic *echinus* again qualifies on this count.

This species contributes materially to our comparison of morphologic and physiologic data in taxonomy. The agamic insects of the several varieties are all similar, and in several cases practically identical; the bisexual insects are as nearly identical; the bisexual galls are indistinguishable in three varieties, but the agamic galls are so distinct that most workers would accept them as the work of different species. Were we dealing with a group of insects in which we had no such physi-

ologic data as the galls, it is quite certain that no one would arrive at our present classification, and the accompanying host and distributional data would then be largely meaningless. How much insect taxonomy is inadequate and misleading is a matter for serious contemplation.

That the differences in these agamic galls are not due to the qualities of the various oaks on which they occur, is proved by the occurrence of three types of galls, the work of three different varieties of *echinus,* on *Quercus dumosa* in Southern California.

Attention should be drawn to the peculiar, crystalline materials of which all these agamic galls are built. Between the thin epidermis and the wall of the larval cell there are solid masses of microscopic, deformed crystals intermingled with a few fibers of similar material. This substance is commonly reputed to be gallic acid (as in Fullaway 1911), and if this is so, these galls must have a very high percentage of the material. It would be interesting to know how the gall in its development segregates or stimulates the manufacture of this substance in the normal oak leaf. When the galls are moist (whether young or old) they are as soft as rubber. When dried, they quickly become as hard to cut with a knife or drill as tho they were made of so much compacted, ground glass. In order to mount such specimens on insect pins for preservation in our collections we soak the galls in water for a few hours, or place them out-of-doors in a damp location for a few days, after which they are readily penetrated by the pins.

In addition to the six varieties now known in this species, there are probably two or three additional varieties still to be described from California, but probably none to be expected elsewhere in this country.

Cynips echinus variety **douglasii**
agamic form **douglasii** (Ashmead)

Figures 23, 154-159, 175

Holcaspis douglasii Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 127. Cockerell, 1900, Ent. Stud. 1: 9. Thompson, 1915, Amer. Ins. Galls: 10, 39.

Dryophanta Douglasi Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 290.

Holcaspis Douglasi Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53.

——[no name] Kellogg, 1904, Amer. Ins.: fig. 661.
Holcaspis douglasii Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 37, pl. 8 fig. 10-11.
Diplolepis douglasi Dalla Torre and Kieffer, 1910, Das Tierreich 24: 369, 816. Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 338.
?Disholcaspis Douglasii Trotter, 1910, Boll. Lab. Zoöl. Portici 5: 115, fig. 11, pl. 1 fig. 13-14.
Dryophanta douglasi Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 352. McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1): 12. Essig, 1926, Ins. Western No. Amer.: 809, fig. 679.
Disholcaspis douglasii Felt, 1918, N.Y. Mus. Bull. 200: 106 fig. 64 (10-11).
Disholcaspis douglasi Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 398.
——[no name] Leach, 1923, Oakland (Calif.) Tribune Mag., May 6, 1923: 11, fig.
Diplolepis Douglasi Houard, 1928, Marcellia 24: 108, fig. 45.

FEMALE.—With almost no constant distinctions from the agamic female of variety *echinus*. Head rich rufous, brightest directly about

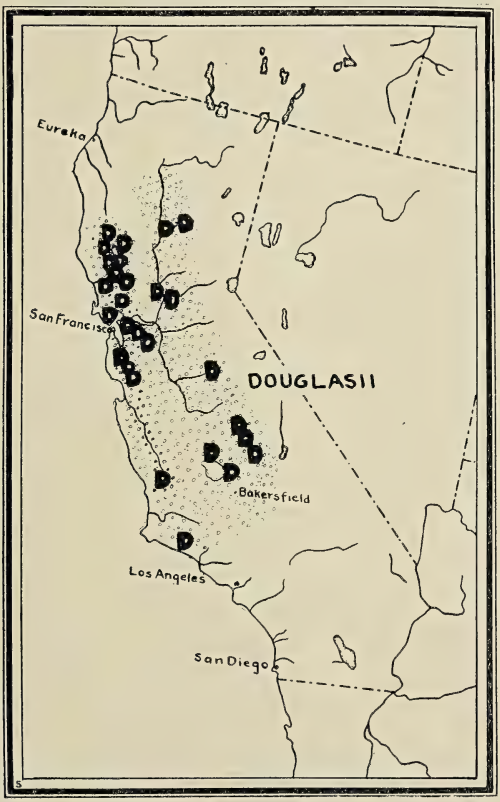


FIG. 23. CYNIPS ECHINUS DOUGLASII ON QUERCUS LOBATA
Possible extension of known range shown by shading.

the eyes, darker to blackish on the median ridge and on the mouthparts; thorax rich rufous, blackish in many places especially between the parapsidal grooves and about the lateral lines; foveal groove sometimes smoother than the rest of the scutellum, hardly rugose, without a division into foveae; abdomen dark rufous, in part blackish, occasionally wholly black; the clouded patches in the discoidal cell less distinct than in variety *echinus;* length 1.5 to 3.5 mm., averaging nearer 3.0 mm. Figure 175.

GALL.—Squash-shaped, an irregular, truncated cone attached by its smaller end, flaring distally, with 5 to 11 short, spiny projections from the rim of the distal end of the gall; mature galls pale pink, often with a puberulence which makes them more violet in color. On leaves of (usually) *Quercus lobata,* rarely on *Q. Douglasii.* Figures 154-159.

RANGE.—California: 5 miles north of Upper Lake (galls, Hildebrand and Schulthess in Kinsey coll.). Konocti Bay in Lake County, and Napa County 12 miles southeast of Middletown (Schulthess and Hildebrand in Kinsey coll.). Inskip and Vina (galls, Leach in Kinsey coll.). Scott Valley in Lake County (gall, P. Schulthess in Kinsey coll.). 7 miles southeast of Kelseyville (Hildebrand in Kinsey coll.). Kelseyville (P. Schulthess in Kinsey coll.). Clear Lake, Napa, and Diablo (Leach in Kinsey coll.). Sonoma County (in U.S. Nat. Mus.). Sacramento (gall, in Kinsey coll.). Marin County (Koebele, types). Walnut Creek (C. T. Dodds in Kinsey coll.). Woodland (gall, L. Ewart in Kinsey coll.). Stanford University (McCracken in Mus. Comp. Zool.). Morgan Hill (gall, G. Reed & Z. Cunningham in Kinsey coll.). San José (Patterson acc. Fullaway 1911). Byron, Paso Robles and Three Rivers (Kinsey coll.). El Portal (gall, Silvestri in Kinsey coll.). Klink on St. Johns River, and Dinuba (L. H. Powell in Kinsey coll.). Hanford (E. O. Essig in Kinsey coll.). Tulare (O. E. Brown in Kinsey coll.).

Probably thruout the Great Valley of California, wherever *Q. lobata* occurs. Figure 23.

TYPES.—7 females and numerous galls in the U.S. National Museum, Cat. No. 3081. From Marin County, California; bred December 19, 21, and 24, 1895; from *Q. lobata* (wrongly determined as *Q. douglasii* by Ashmead).

The present re-descriptions are studies of all the type material compared with numerous series from Central California.

The gall of this agamic form is common on the valley white oak, *Quercus lobata,* thruout the Great Valley of California. The young galls appear late in June (June 28, 1927, near Kelseyville, and July 6 at Diablo in 1922), and many of them are fully grown by the middle of August. Galls collected on September 10 (at Inskip in 1925) were fully grown, but the insects were still so young they could not be bred after collecting. The larvae mature sometime after the first of Oc-

tober (before October 4 at Kelseyville and October 16 at Diablo in 1925); and adults may be found in the galls soon afterwards. The pupal period is short, and for a time in October and November mature larvae, pupae, and immature adults may be obtained from a single collection.

Adults, not yet fully pigmented, were in the galls at Kelseyville on October 30, and on October 29 at Diablo in 1925. These adults do not begin emerging until the end of November (November 26 from Diablo material in 1925, and November 28 acc. McCracken coll.), or after the first of December (December 19-24 acc. Ashmead, and December 18-29 from Diablo material in 1922). Kelseyville material bred here at Bloomington, Indiana, emerged out-of-doors early in January (in 1926), and a few of the insects emerged as late as February 1 (in 1927). In the field the galls collected by the last of January (at Diablo) are usually empty of insects except for the parasites and inquilines which emerge at later dates. One very large collection made at Diablo as early as December 18 (in 1922) was already empty of gall-making Cynipidae. The records of indoor breedings are usually later: January and February acc. McCracken, and January in my own experience; but it should be noted again that increased temperatures appear to delay emergence in many Cynipidae. The succeeding generation, a form named *lobata,* appears with the bursting of the buds in March or April.

In November the agamic galls fall to the ground either attached to or separated from the leaves, or the galls remain attached to the leaves which hang on the trees over winter. The galls on the ground are decayed soon after the first of the year, but good specimens may still be found on the trees in the spring (as late as March 7 at Paso Robles in 1920).

Ashmead accredited this insect to *Quercus Douglasii,* but the fragments of leaves with the type galls are clearly those of *Q. lobata.* The *Douglasii* record is copied in most of the literature, altho two students (Fullaway and McCracken) who have known this variety in the field have pointed out that the white oak, *Q. lobata,* is the real host. Of the several thousand galls which Mr. F. A. Leach collected for me from a number of localities and at all seasons over a period of four years, practically every one came from *Q. lobata;* but two meager collections, a total of 21 galls found in 1922 at Di-

ablo, seem to have come from *Q. Douglasii.* My records show that for at least one of these collections I verified the host determination while noting its unique nature. It is, however, inconvenient that an insect that is all but confined to *Q. lobata* should carry the name *douglasii,* and the situation is the more unfortunate because the bisexual form of this same insect was named *lobata* by McCracken and Egbert.

In distribution this variety for the most part parallels *echinus,* wherever the hosts of the two occur together. But while *echinus* is replaced by another variety at the higher elevations fringing the Great Valley, I would refer insect and gall material which I have from Lake County to typical *douglasii.* I have 46 fine insects from Kelseyville alone, and cannot find material differences between them and *douglasii* unless the Lake County material averages darker. In the consideration of the reality of life zones, perhaps this case should be emphasized as an instance where two, very closely related insects (*douglasii* and *echinus*) do not respond in the same way to the same geographic factors.

If there are constant characters by which *douglasii* may be distinguished from *echinus,* no one has yet described them. Upon examining a large series of the insects, I find the color distinctions noted by Fullaway are highly variable. The distinctive form of the gall and the host seem to provide the only marks for recognizing this insect. It is surprising that no one has previously adjudged *echinus* and *douglasii* to be varieties of one species.

Cynips echinus variety **douglasii**
bisexual form **lobata** (McCracken and Egbert)

Figures 23, 180

Dryophanta lobata McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1) : 13, pl. 1 fig. 9.

FEMALE AND MALE.—With the first two segments of the antenna in the female rufous yellow, the entire antenna in the male brownish black; the parapsidal grooves distinct to the pronotum; the scutellum rather smooth, smoothest anteriorly; the foveal grooves finely roughened at bottom. Figure 180.

GALL.—Closely resembling the galls of the other bisexual forms of the species; perhaps more ovoid when fresh, the surfaces then pebbled, bearing low, indefinite ridges which terminate in short, soft spines especially near the apex of the gall; on *Quercus lobata.*

RANGE.—Probably as given for the agamic form of variety *douglasii* (fig. 23). The bisexual form known definitely from the Californian towns of Kelseyville (P. Schulthess in Kinsey coll.), Stanford University (McCracken in Stanf. Univ.), Three Rivers (Kinsey coll.), and Ojai (gall in U.S. Nat. Mus.).

TYPES.—15 females, 15 males, and galls. Holotype and paratype females (and galls?) at Stanford University; paratype males in the Kinsey collection; a gall in the U.S. National Museum. From the Stanford Campus; April 1917; *Q. lobata;* I. McCracken collector.

The present study is based on the type material in the Kinsey and National Museum collections, compared with material from Kelseyville and Three Rivers, California.

These galls first appear in March or early April. The adults emerge before the end of April (April 21 at Kelseyville in 1926), and two or three weeks earlier farther south. It is another month and a half before the appearance of the galls of the agamic form, *douglasii.*

Cynips echinus variety **echinus**

agamic form **echinus** Osten Sacken

Figures 24, 156-158, 163, 176, 191

Cynips quercus echinus Osten Sacken, 1870, Trans. Amer. Ent. Soc. 3: 56.

Cynips echinus Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 295, 303. Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 176. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 109. Dalla Torre, 1893, Cat. Hymen. Cynip. 2: 68. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 59. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 440, 812. Thompson, 1915, Amer. Ins. Galls: 19. Houard, 1928, Marcellia 24: 115, fig. 79-80.

Andricus speciosus Bassett, 1890, Trans. Amer. Ent. Soc. 17: 81. Dalla Torre, 1893, Cat. Hymen. Cynip. 2: 101. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 65. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 24. Thompson, 1915, Amer. Ins. Galls: 19, 33. Felt, 1918, N.Y. Mus. Bull. 200: 109. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 202.

Dryophanta speciosa Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 290.

——[no name] Kellogg, 1904, Amer. Ins.: fig. 658.

Diplolepis speciosa Dalla Torre and Kieffer, 1910, Das Tierreich 24: 368, 812.

Dryophanta echinus Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 351, pl. 13 fig. 6. Felt, 1915, N.Y. Mus. Bull. 180: 115.

Diplolepis echina Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 337. Fullaway, 1912, Journ. N.Y. Ent. Soc. 20: 281.
Dryophanta echina Felt, 1918, N.Y. Mus. Bull. 200: 106, fig. 99 (6). McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1): 11. Essig, 1926, Ins. Western No. Amer.: 809, fig. 678.
Cynips echinus var. B Kinsey, 1927, Field and Lab. Manual in Biol.: 104.

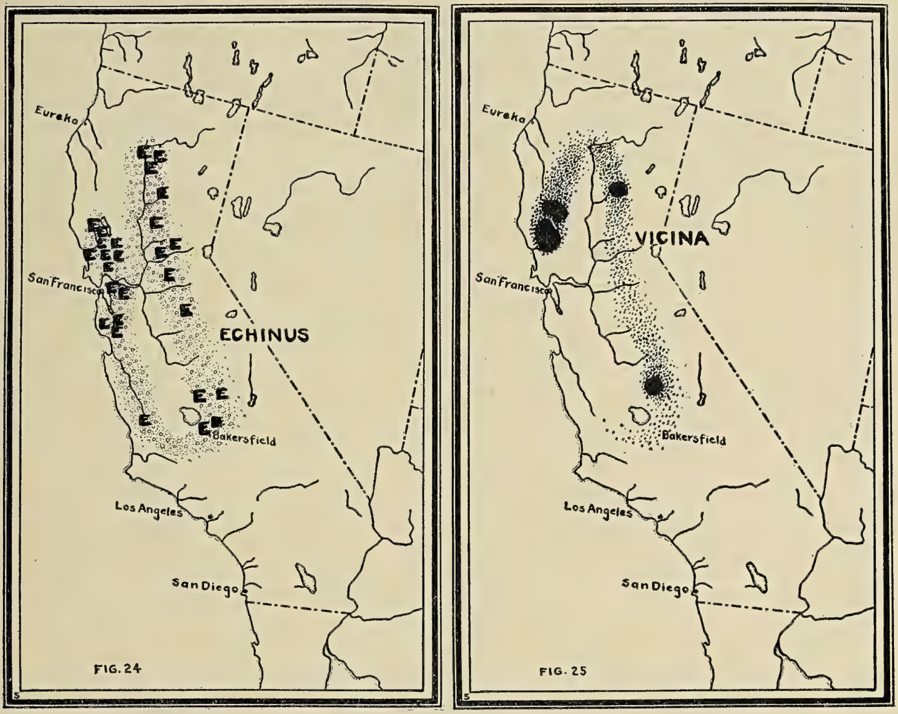
FEMALE.—With almost no constant distinctions from the agamic female of variety *douglasii.* Head rich rufous, brightest directly about the eyes, darker to blackish on the median ridge and on the mouthparts; antennae rufous basally; thorax rich, dark rufous, blackish in many places, especially between the parapsidal grooves and about the lateral lines; foveal groove sometimes smoother than the rest of the scutellum, hardly rugose, without a division into foveae; abdomen dark rufous, in part blackish, occasionally wholly black; the clouded patches in the discoidal cell more distinct than in *douglasii;* length 1.5 to 3.5 mm., averaging nearer 3.0 mm. Figures 163, 176.

GALL.—Indistinguishable from that of the agamic form of variety *vicina.* Quite regularly spherical, entirely covered with from 20 to 60 spiny projections, these broadest where they are fewest in number; mature galls bright to dark coral red, or coral red with a violet bloom, not as often puberulent as in variety *douglasii;* on *Quercus Douglasii.* Figures 156-158, 191.

RANGE.—California: Redding, South Cow Creek, northeast Napa County, and Battle Creek at 2000 ft. (galls, F. A. Leach in Kinsey coll.). Shasta County and Kern County (in U.S. Nat. Mus.). Inskip, Colfax, and Diablo (F. A. Leach in Kinsey coll.). Kelseyville, Scott Mountain in Lake County, and Cobb Mountain in Lake County (P. Schulthess in Kinsey coll.). Oroville and Three Rivers (Kinsey coll.). Winters (Vansell in Univ. of Calif. and Kinsey coll.). Napa (E. H. King coll.; *speciosus* types). Sonoma County (Koebele in U.S. Nat. Mus.). St. Helena (acc. Fullaway 1911). Foothills in Placer County (Osten Sacken; *echinus* types). New York Falls in Amador County (G. Hansen acc. Houard 1928). Contra Costa County (galls, W. W. Jones in Kinsey coll.). San José (gall, acc. Felt 1915, E. Bethel coll.). Morgan Hill (gall, G. Reed and Z. Cunningham in Kinsey coll.). Hornitos (acc. McCracken and Egbert 1922). Dinuba (L. H. Powell in Kinsey coll.). Bakersfield (H. H. Bauer in Kinsey coll.). Paso Robles (gall, Kinsey coll.).

Probably thruout the Great Valley wherever *Q. Douglasii* occurs, replaced in Lake County and at other higher elevations by variety *vicina.* Figure 24.

TYPES.—Of *echinus:* Females and galls in the Osten Sacken collection at the Museum of Comparative Zoology; 3 females cut from paratype galls, and galls at the U.S. National Museum; a gall at the American Museum of Natural History. From the lower foothills of Placer County, California; the host determined (certainly in error!) as *Q. agrifolia.*



FIGS. 24-25. CYNIPS ECHINUS VARIETIES ON QUERCUS DOUGLASII

Possible extensions of known ranges shown by shading.

Of *speciosa:* Holotype and 3 paratype females and galls at the Philadelphia Academy; paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, the U.S. National Museum, the Beutenmüller collection (?), and the Kinsey collection. From Napa City, California, E. H. King collector.

Type material of both *echinus* and *speciosa,* including the holotype of the latter, was examined in making the present re-descriptions.

This gall, found on the blue oak, *Quercus Douglasii,* is one of the most abundant of the cynipid productions in California. The young galls appear about the middle of July; in 1922 Leach failed to find galls at Diablo on July 4, but found young galls on July 17. The galls are mature by the first of September and are then very striking objects, forming deep, coral red clusters of spiny spheres on the under surfaces of the leaves. The larvae do not mature until later in the fall, transforming into pupae and adults in November. Emergence may occur as early as November 26 (in 1922 at Diablo), but

may continue to the first of January (January 8, 1922, at Diablo). Some material from Kelseyville, California, was bred out-of-doors at Indiana University in the winter of 1925-26, when emergence occurred between January 15 and January 30, 1926. It is probable that field records would place the bulk of the emergence late in December and in January. McCracken and Egbert give a January record for material bred indoors, suggesting that "This is probably premature emergence"; but with at least many Cynipidae of fall generations increased heat retards rather than hastens emergence.

The succeeding, bisexual generation of *echinus* is form *ribes*, to be found in bud galls on the trees in the following March or April.

Late in the fall the galls of *echinus* fall to the ground, attached to or separated from the dying leaves, but so many of the leaves of the blue oak persist on the trees thru the winter that many galls remain in good condition into the spring (March 7, at Paso Robles in 1920).

The blue oak, *Q. Douglasii,* is the only host I have observed for this variety, altho I have examined specimens representing twenty-four localities (including material collected on the blue oak by the Fremont expedition in 1849). Fullaway and McCracken, who were in a position to study the material in the field, similarly credit this insect to the blue oak. Osten Sacken described *echinus* from *Quercus agrifolia,* and this record has been conscientiously copied without, as far as I am aware, any further proof that this was not a mistaken determination of the host. Bassett made no determination of the host of his *speciosus.* Kellogg, in his American Insects (fig. 658) states that these galls are on white oak (*Q. lobata*), but the drawing shows a typical blue oak leaf. Whether this insect will ever be found as a stray on any other oak, it should be recognized that it is now known from *Q. Douglasii* only.

The insect of this variety seems indistinguishable from that of variety *douglasii* (*q. v.*), but the galls of the two will never be confused unless in their very young stages. There is no constant distinction of the gall of *echinus* from *vicina* (*q. v.*), a variety which to a large extent replaces typical *echinus* in Lake County and at other points fringing the Great Valley. True *echinus* ranges without appreciable variation thruout the

length of the Great Valley, for 420 miles between Bakersfield in Kern County and Redding in Shasta County; but within a short twenty miles in southern Lake County *echinus* gives way to *vicina*. There seems little room to question that the geographic uniformity of the Great Valley, providing an area within which interbreeding may proceed without hindrance, is the explanation of the wide range and constancy of *echinus;* and that the geographic isolation of the Lake County area, offering its barriers to the interbreeding of Lake County and Great Valley material, is the abundant explanation of the preservation of the mutant stock which is *vicina*.

Beutenmüller recognized the identity of Osten Sacken's *echinus* and Bassett's *speciosa* and published the synonomy in 1911. He has been followed by most of the later authors, and my own studies of the type material of these two names lead me to agree. Osten Sacken's name *echinus* is a substantive which should not be changed to *echina* as tho it were an adjective agreeing with the generic name.

Cynips echinus variety **echinus**

bisexual form **ribes** (Kinsey)

Figures 24, 159, 160, 161, 181, 194

Andricus ribes Kinsey, 1922, Ind. Univ. Study (9) 53: 42.

FEMALE AND MALE.—Hardly distinct from the bisexual females and males of the other varieties of the species; the first four or five segments of the antenna in the female rufous yellow, the entire antenna brownish black in the male; parapsidal grooves distinct to the pronotum; the scutellum roughly even tho not deeply rugose; the foveal groove finely roughened at bottom. Figures 160, 161, 181.

GALL.—Closely resembling the galls of the other bisexual forms of the species; perhaps more ovoid when fresh, the surface then pebbled, bearing low, indefinite ridges which terminate in short, soft spines especially near the apex of the gall; on the young twigs of *Quercus Douglasii*. Figures 159, 194.

RANGE.—Probably as given for the agamic form of variety *echinus* (fig. 24). The bisexual form known definitely from the Californian towns of Oroville and Three Rivers (Kinsey coll.), and Los Gatos (in U.S. Nat. Mus.).

TYPES.—16 females, 10 males, and 48 galls, the adults all imperfect. Holotype and paratype females, paratype males, and galls in the American Museum of Natural History; paratype females, males, and galls in Stanford University, the U.S. National Museum, and the Kinsey

collection. Labelled Oroville, California; galls April 1, 1920; *Q. Douglasii;* Kinsey collector.

The present re-descriptions are new studies of the holotype and the paratypes in the American Museum and Kinsey collections.

My material collected at Three Rivers on March 23 and at Oroville on April 1 (both in 1920) had just appeared with the young oak leaves, but the adult insects emerged from these galls within a few days. The eggs, laid in the veins of the young leaves of the blue oak, apparently do not hatch for a couple of months. In early July, the galls of the agamic form, *echinus,* begin to appear.

The bisexual form of variety *vicina* is so close to *ribes* that the two should be carefully compared in making determinations in this group.

Cynips echinus variety **vicina,** new variety

agamic form **vicina,** new form

Figures 25, 177

Cynips echinus var. C Kinsey, 1927, Field and Lab. Manual in Biol.: 104.

FEMALE.—Very dark rufous and black, the entire body including the legs and antennae often black; foveal groove usually smooth at the bottom, with a very fine ridge dividing it indistinctly; clouded patch distinct in the cubital cell, but the patches in the discoidal cell very faint or wholly lacking; length 1.7 to 2.8 mm., averaging nearer 2.2 mm., distinctly smaller than the variety *echinus.* Figure 177.

GALL.—Indistinguishable from that of variety *echinus,* unless averaging a bit smaller. Quite regularly spherical, entirely covered with from 20 to 60 spiny projections, these broadest when they are fewest in number; mature galls bright to dark coral red or coral red with a violet bloom, not as often puberulent as in variety *echinus;* on *Quercus Douglasii.*

RANGE.—California: 7 miles south of Kelseyville (Hildebrand in Kinsey coll.). Kelseyville (Schulthess, types). 5 miles north of Upper Lake (Schulthess and Hildebrand in Kinsey coll.). Scott Mountain in Lake County, Cobb Mountain in Lake County, and northeast and southern sides of Bartlett Mountain in Lake County (Schulthess in Kinsey coll.). Inskip (Leach in Kinsey coll.). Sierran foothills east of Dinuba (L. H. Powell in Kinsey coll.).

Apparently occurring over an area extending from Lake County in a narrow fringe about the Great Valley of California. Figure 25.

TYPES.—17 females, many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the

American Museum of Natural History and the U.S. National Museum. Labelled Kelseyville, California; galls September 28, 1924, September 20 and October 4, 1925, and September 26, 1926; *Q. Douglasii;* P. Schulthess collector.

Both varieties *echinus* and *vicina* occur on the blue oak, *Q. Douglasii,* and the galls of the two cannot be distinguished. The small size, dark color, and smoother foveae of *vicina* clearly differentiate most of the material I have. The bisexual forms of *echinus* and *vicina* are about as close as the agamic forms, but they do show differences enough to lend some weight to our recognition of two varieties here. The insects of the agamic *vicina* are not entirely distinct from those of either varieties *schulthessae* or *mista,* but these three varieties are separated by their distinctive galls and hosts.

While *echinus* occurs thruout the Great Valley, *vicina* is probably restricted to a narrow area bordering the Valley. Jepson defines this area (1925, Manual Flowering Plants Calif., p. 12) for the higher plants. The localities recorded for *vicina* are all adjacent to the Great Valley but at points spread over several hundred miles. *Vicina* cannot be considered a trivial variant of *echinus,* for we have enough material of *echinus* to understand its distribution and variation. At three of the localities for *vicina* some typical *echinus* insects were obtained, but the insects do interbreed in places.

At Colfax, in Placer County, where we might have expected *vicina,* a dozen insects collected by Mr. Leach (in 1922) proved to be typical *echinus.*

The life history of *vicina* probably matches that of *echinus.* Galls not more than two-thirds mature were collected at Lower Lake on August 28 (1927). Mature galls were collected at Inskip on September 9 (in 1925), and at Kelseyville on September 26 (in 1926) and 28 (in 1924). Some of the Bartlett Mountain material collected October 31 (in 1926) emerged (out-of-doors at Bloomington, Indiana) on January 8 and 21 (1927), while other galls of the same collection still contained larvae on February 1 (1927). Two of these larvae matured into adults which emerged at some (undetermined) date after the first of February. The Inskip material emerged about the middle of January (in 1925), and on January 20 (1925) some dead and some live adults were in the breeding bags, while some dead and some live adults were still in the galls.

The Dinuba material was emerging on January 20 (in 1925). My Scott Valley material emerged on January 21 (1926).

The eggs, layed in mid-winter, give rise to the galls of the bisexual *incepta* in March or April.

Cynips echinus variety **vicina**

bisexual form **incepta,** new form

Figures 25, 182

FEMALE AND MALE.—With the entire antenna in both sexes brownish black; the parapsidal grooves distinct to the pronotum; the scutellum distinctly smooth, most so anteriorly, the foveal groove smooth at bottom. Figure 182.

GALL.—Closely resembling the galls of the other bisexual forms of the species; perhaps more ovoid when fresh, the surface then pebbled, bearing low, indefinite ridges which terminate in short, soft spines especially near the apex of the gall; on young twigs of *Quercus Douglasii.*

RANGE.—Probably as given for the agamic form of variety *vicina* (fig. 25). The bisexual form known definitely only from Kelseyville, California (P. Schulthess coll.).

TYPES.—2 females, 8 males, and 11 galls. Holotype and paratype females, males, and galls in the Kinsey collection. Galls at the American Museum of Natural History and the U.S. National Museum. Labelled Kelseyville, California; galls April 11 and May 8, 1926; insects April 21, 1926; *Q. Douglasii;* P. Schulthess collector.

The galls collected by Miss Schulthess on April 11 (1926, at Kelseyville) were full-sized and contained larvae that soon transformed into adults which emerged on April 21. Ten adults were recovered from eleven galls, but only two of the adults were females. Galls collected from the same locality on May 8 (also 1926) were all empty of adults.

We may expect to find the bisexual forms of two varieties of this species on *Quercus Douglasii* at Kelseyville, since there are two agamic insects, *echinus* and *vicina,* on that oak in that locality. The material here interpreted as the bisexual form of *vicina* is certainly distinct from *ribes.* The type material of *ribes* came from Oroville, a locality well inside the range of form *echinus* and therefore the probable alternate of *echinus* rather than of *vicina. Incepta* then should be the alternate of the agamic *vicina,* a conclusion that is also favored by the fact that *vicina* is the more common of the two agamic

forms on the blue oak at Kelseyville. *Incepta* and *vicina* also agree in being darker than the other insects of the species, and in having foveal grooves which are distinctly smooth at bottom.

Cynips echinus variety **dumosae,** new variety

agamic form

Figures 26, 147-149, 179

Cynips echinus var. A Kinsey, 1927, Field and Lab. Manual in Biol.: 104.

FEMALE.—Head, thorax, and legs entirely bright, brownish rufous, the antennae dark brown terminally and lighter basally; foveal groove weakly and sparingly sculptured at the bottom, rather distinctly divided by a very fine ridge; abdomen bright, reddish rufous, only darker rufous in places; the cloud in the cubital cell light, the patches in the discoidal cell even lighter; in length about 2.7 mm., averaging smaller than *echinus* or *douglasii.* Figure 179.

GALL.—Irregularly cushion-shaped, spheroidal, more or less flattened in places, the base more or less constricted, the apical end more or less widened and flattened, bearing a few, very short and blunt projections mostly on the rim at the top of the gall; mature galls light but dull, brick-red in color, the surface dull and often partly violet because of a puberulence; on *Quercus dumosa* and *Q. turbinella.* Figures 147-149.

RANGE.—California: Paso Robles, Pasadena, and Upland (Kinsey coll.). El Toro, Sorrento, Fallbrook, and Alpine (galls, Kinsey coll.). Jacumba (*Q. turbinella,* A. E. Stanley in Kinsey coll.).

Probably thruout more southern California wherever *Q. dumosa* and the closely related scrub oaks occur, from San Diego County to Palo Alto, except in the San Bernardino range. Figure 26.

TYPES.—19 females, 18 galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, and the U.S. National Museum. Labelled Upland, California; February 3, 1920; *Q. dumosa;* Kinsey collector. Collected in San Antonio Canyon on the side of the San Antonio Mountains.

While never as abundant as varieties *echinus* and *douglasii* of more central California, this species is not rare in Southern California wherever the scrub oaks, *Q. dumosa* and related species, grow. All of our records give *Q. dumosa* as the host, except the Jacumba material which is from *Q. turbinella,* an oak that is hardly more than a variety of *Q. du-*

mosa. The insects of this Jacumba material vary somewhat in color, averaging darker than the types of *dumosae,* suggesting that another variety, perhaps centering in Lower California, interbreeds with typical *dumosae* on the California-Mexican border; but our present data do not yet warrant the recognition of such a variety. In the San Bernardino area the present variety seems to be replaced by another insect, variety *mista.*

From galls collected by Miss Stanley at Jacumba four insects emerged (out-of-doors at Bloomington, Indiana) on January 7 (1927). The type material was collected near Upland on February 3 (in 1920), when the galls showed that many of the insects had previously emerged, altho other adults emerged on that day and still later. All the gall makers had emerged from the galls collected later in February at several other points in southern California. Thus, emergence is later with this insect than with the more northern varieties of the same species.

I have no further data on the life history of *dumosae.* The more northern varieties of the species have two, alternating generations, but it is possible that this southern variety has but one, an agamic generation each year. Such a condition certainly exists among some of the other Cynipidae of southern California, the young galls appearing in February and March a few weeks after the agamic adults have emerged from the practically identical galls of the previous generation.

In addition to the undescribed variety indicated by our Jacumba material, galls of still another segregate of *echinus* were collected at extreme southern points in California. It occurs on *Q. dumosa* and its range overlaps that of variety *dumosae* near the town of Alpine.

Cynips echinus variety **mista,** new variety

agamic form

Figures 26, 150, 184

Cynips echinus var. D Kinsey, 1927, Field and Lab. Manual in Biol.: 104.

FEMALE.—Very dark rufous to piceous and black, the entire antenna and all the legs dark rufo-black; foveal groove sparingly rugose at bottom; clouded patches in both cubital and discoidal cells distinct; length 2.4 mm. Figure 184.

GALL.—Very close to that of variety *dumosae,* distinguishable chiefly by its more shining surface. Irregularly cushion-shaped, spheroidal, more or less flattened in places, the base more or less constricted, the apical end more or less widened and flattened, bearing a few, very short and blunt projections mostly on the rim of the gall; mature galls yellowish and rose or brownish red, the surface shining, varnished, without a puberulence; on *Quercus dumosa.* Figure 150.

RANGE.—California: Victorville (types; V. H. Ward in Kinsey coll.). Northeastern Los Angeles County (galls, W. Ebeling in Kinsey coll.).

Probably restricted to a limited area in or just north of the San Bernardino Mountains. Figure 26.

TYPES.—One female and many galls in the Kinsey collection. Paratype galls in the Museum of Comparative Zoölogy, the U.S. National Museum, the American Museum of Natural History, the California Academy, and the Stanford University collections. Labelled Victorville, California; galls September 5, 1926; *Q. dumosa;* V. H. Ward collector.

The galls of this variety are almost identical in shape with those of *dumosae.* The two occur on the same host, but *mista* galls may be distinguished by their shining surfaces that appear as tho they were varnished. The insect of *mista* is very dark rufous in color and in every respect closer to variety *vicina* and thus readily distinguished from the light brownish insect of *dumosae.* It is very interesting to find the insect physiologically similar to its nearest neighbor (*dumosae*) on the south, and morphologically more like its neighbor (*vicina*) to the north. It is possible that the insect originated as a hybrid of *dumosae* and *vicina,* or just as possible that it achieved its characters by entirely independent evolution from some common stock of all these varieties.

The two collections we have of *mista* come from the broken mountain ridges that extend northward from the San Bernardino range into the Mojave Desert, an area in which a distinct variety might become isolated. But the San Bernardino range itself usually has a fauna distinct from that of the other mountains of California, and the range of *mista* may include the whole San Bernardino area.

The type galls were collected at Victorville by Mr. V. H. Ward, a High School teacher in Monrovia, California, on September 5, 1926, at which time they were full-sized altho the larvae they contained were still very small. Only one of these insects succeeded in maturing and emerging from the galls at some (undetermined) time in the following winter.

Cynips echinus variety **schulthessae,** new variety
agamic form **schulthessae,** new form

Figures 26, 151-153, 165, 174, 178, 193

FEMALE.—Generally rich, dark rufous; foveal groove distinctly smooth at the bottom, with a very fine ridge dividing it indistinctly; a clouded patch in the cubital cell, but the patches in the discoidal cell faint or lacking; length 1.5 to 3.5 mm., averaging nearer 2.5 mm. Figures 165, 174, 178.

GALL.—Very deep bowl-shaped, or vase-shaped, entirely without the spines found in the agamic forms of other varieties; a more or less regular cylinder or truncate cone attached by a not very narrow base, only moderately widened apically; the gall about as high as the apical diameter; the top of the gall more or less depressed centrally, making an irregular, thin edge which is only rarely dissected to suggest the

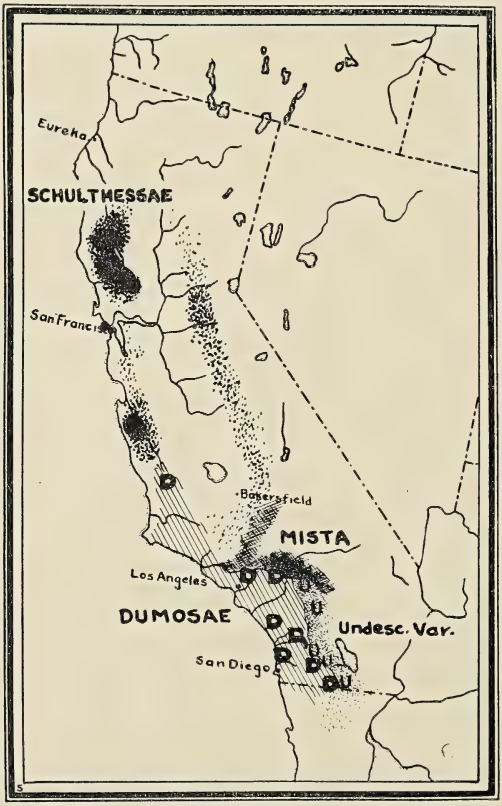


FIG. 26. CYNIPS ECHINUS VARIETIES ON QUERCUS DUMOSA AND RELATIVES

Showing geographic isolation of related insects.

spines found in other varieties; mature galls light yellowish in color, only occasionally tinged pink, with a puberulence which only occasionally looks purplish, weathered galls turning dark brown and then black; internally not as hard as in other varieties; on *Quercus durata* and *Q. dumosa*. Figures 151-153, 193.

RANGE.—California: 7 miles southeast of Kelseyville (galls, Hildebrand in Kinsey coll.). Seigler Springs (Hildebrand in Kinsey coll.). Kelseyville (Schulthess, types). 6 miles west of Highland Springs, Scott Valley in Lake County, and the northeast side of Bartlett Mt. in Lake County (Schulthess in Kinsey coll.). Middletown and Clear Lake (galls, F. A. Leach in Kinsey coll.). Howell Mt. in northwestern Napa County (H. W. Clark in Kinsey coll.). Winters (galls, Vansell in Univ. of Calif. and Kinsey coll.).

Probably confined to an area including Lake County and parts of the adjacent counties. Figure 26.

TYPES.—9 females and 66 galls. Holotype female, paratype females, and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History, the U.S. National Museum, and Stanford University. Labelled Kelseyville, California; galls September 20, 1925, and September 26, 1926; *Q. durata;* P. Schulthess collector.

Four years ago Mr. F. A. Leach collected galls of this variety, but I failed to breed insects from them. During the past three years Miss Pauline Schulthess, of Kelseyville, has secured fine collections of the galls from which insects have emerged. Miss Schulthess has done a splendid piece of work in collecting the galls of Lake County, an area that has been practically neglected heretofore as far as Cynipidae are concerned, altho it is biologically distinct from either the Great Valley or the Coast Ranges of California. I take pleasure in recording the fact that a young student's eyes and energy may contribute much to taxonomic science. Many other Lake County records based on the same collector's material will be found elsewhere in this study, often in connection with varieties and species which have not been previously described.

Galls collected by Miss Dorothy Hildebrand, near Kelseyville on July 26 (1927) were young and for the most part small, altho a few of them were of full size. Galls collected on September 1, (1927) and September 2 (in 1925) were full size and the larvae were not small. Bartlett Mountain material collected October 31 (1926) emerged out-of-doors at Bloomington, Indiana, on January 7 (1927). The Kelseyville material had not yet emerged on January 12 (1926), but on

January 29 ten adults were found emerged and dead while live gall maker larvae were still in the galls. These larvae were active at noon of that day, altho the official temperature record was but 38°F., and our breeding box still contained ice; and the activity of the larvae was the more remarkable when it is noted that a temperature of 0°F. had been recorded only six hours before. A number of adults later emerged from these galls, on dates between January 30 and February 10. Inquilines emerged from some of our galls early in the June (1927) following the emergence of the gall makers.

The insects of *schulthessae* closely resemble the insects of *vicina*, a Lake County variety which occurs on *Q. Douglasii*, but *vicina* galls are indistinguishable from those of *echinus*, while the galls of *schulthessae* are very distinct in form.

The bisexual generation of this variety is form *atrata*, for the first collection of which we were again indebted to Miss Schulthess' labors.

Cynips echinus variety **schulthessae**
bisexual form **atrata**, new form

Figures 26, 166, 183

FEMALE AND MALE.—With the first four or five segments of the antennae in the female rufous yellow, the entire antenna brownish black in the male; parapsidal grooves quite indistinct anteriorly; the scutellum irregularly and distinctly (tho not deeply) rugose; the foveal groove more or less smooth at bottom. Figures 166, 183.

GALL.—Resembling the galls of the other bisexual forms of the species, but more nearly spherical when fresh, with fewer irregularities and practically no spines on the surface; on the young twigs of *Quercus durata* (and probably *Q. dumosa*).

RANGE.—Probably as given for the agamic form of *schulthessae* (fig. 26). The bisexual form known definitely only from Kelseyville, California (P. Schulthess coll.), and from Paraiso Springs, California (in U.S. Nat. Mus.).

TYPES.—2 females, 1 male, and 6 galls, in the Kinsey collection. Labelled Kelseyville, California; May 1, 1925; *Q. durata;* P. Schulthess collector.

From the galls collected on May 1 (1925, at Kelseyville) adults emerged by May 13. This is the latest date we have for any of the bisexual insects of this species.

The present form is distinct from all other bisexual forms of *echinus* in having parapsidal grooves which are more or less obscured anteriorly. The galls of this form agree with the galls of the agamic form in being almost free of the projecting points found in most of the other varieties of the species.

Cynips (Antron) guadaloupensis (Fullaway)

agamic forms

FEMALE.—Head slightly wider than the thorax; antennae dark brown with the first two segments brownish rufous; thorax somewhat reduced, rufous and darker; mesonotum closely rugoso-punctate and hairy, the parapsidal grooves very fine, extending not more than halfway to the pronotum; anterior parallel lines barely indicated; the lateral lines more evident but short and fine; scutellum distinctly narrow and elongate; abdomen rufous brown and darker; wings shortened, from 0.46 to 0.80 of the body in length, with a reduced venation that is incomplete beyond the first abscissa of the radius; areolet closed; the cells without spots or blotches; length 2.0 to 2.9 mm.

GALL.—Naked, smooth and shining, from circular and disk-like to deep bowl-shaped with a flattened cover, or compressed pouch-shaped. Up to 13.0 mm., averaging nearer 5. mm. in diameter, the galls more or less regular, without spines or other projections; the surface entirely smooth and naked; the young galls purplish rose, in part leaf green, with a light purplish puberulence, the apical rim of the galls sometimes bright red; the older galls straw yellow to yellowish brown and darker, without the puberulence. The outer wall of the gall rather thin, soft and flexible when fresh, hard, crystalline and brittle when dry; with a large, centrally placed larval cell that is usually nearer the apex than the base of the gall, the cell with a poorly defined and inseparable cell wall. The gall attached by a slight, centrally placed projection, singly or in small groups, usually on the under surfaces of the leaves but sometimes on the upper surfaces; on the veins of the leaves of *Quercus chrysolepis, Q. Wilcoxii,* and probably all of the varieties of these oaks.

RANGE.—Known from southern Oregon to southern California and southern Arizona. Probably occurring from Washington into Lower California, Guadalupe Island, and southern Arizona, wherever *Q. chrysolepis* and its close relatives occur. Figure 27.

This is the *Quercus chrysolepis* species of the subgenus *Antron.* The gall is rather common on the canyon oak in the mountains of California, but the adult is represented by only a few specimens in our collections, apparently because the galls have not been collected at a season when they were suit-

able for breeding. W. Ebeling has sent me young galls from the Yosemite as early as June 21 (1928). The scant data indicate the emergence of the agamic adult from late November into December and possibly January. The life histories known for *Cynips echinus*, also of the subgenus *Antron*, suggest that we should look for the alternate, bisexual generation of *guadaloupensis* in a simple, fleshy-walled, capsule-like gall in the buds or on the young twigs of *Q. chrysolepis*. Such a gall is apparently undescribed. This bisexual insect should have the broadened and bluntly plow-shaped spine characteristic of the subgenus, and should be recognizable by this character, its host distribution, and its seasonal occurrence.

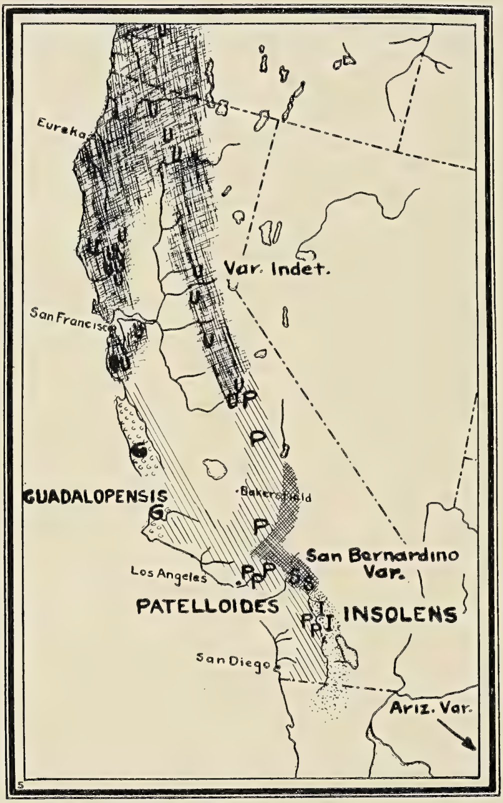


FIG. 27. VARIETIES OF CYNIPS GUADALOUPENSIS
Showing geographic isolation of related insects.

The variety *guadaloupensis* was described from a southern Coast Range area of California, and may (or may not) be

the variety represented in the mountains farther north; variety *patelloides* is common in the southern Sierras and their extension as far south as the San Jacinto range; variety *insolens* is known only from the San Jacinto range but may extend southward into Lower California. Galls representing apparently undescribed varieties or indeterminate material of this same species are at hand or recorded from the following localities:

Oregon: Canyonville (acc. Weld 1926).

California: Baird, Scott Bar, Shasta, Ukiah, Calistoga, Mt. Diablo, El Portal, Redwood Park, Los Gatos, and San Bernardino Mts. (acc. Weld 1926). 6 miles west of Highland Springs, the northeast side of Bartlett Mt. in Lake County, and Cobb Mt. (P. Schulthess in Kinsey coll.). Elk Mt. in Lake County (Schulthess and Hildebrand in Kinsey coll.). Colfax (F. A. Leach in Kinsey coll.). Murphy (J. Laminman in Kinsey coll.). Placerville and Dunsmuir (Kinsey coll.). Yosemite Valley and north of Beaumont (W. Ebeling in Kinsey coll.).

Arizona: Santa Catalina Mts. (on *Q. Wilcoxii,* acc. Weld 1926).

In addition then to the three described varieties, there may be a distinct variety in southern Oregon and northern California, one in the northern Sierras, perhaps another in the central Sierras, and one in the San Bernardino Mountains. I have seen an insect of Weld's collection from this last named area, and it certainly represents an undescribed variety (fig. 169).

Weld has treated our present varieties as species of *Acraspis.* The hypopygial spines are close to those of *Acraspis,* but if allowances are made for the shortened wings of *guadaloupensis,* the rest of the insect characters are good for *Antron,* and the galls of *guadaloupensis,* which Weld did point out "are of a different type from those of the eastern species" of *Acraspis,* are in structure typical for *Antron.* Indeed, the galls of variety *patelloides* of the present species are strikingly similar to those of *Cynips echinus schulthessae,* the type of the subgenus.

The insects of the three described varieties of the present species seem distinguishable on nothing but minor color variations, by the shorter wings of variety *guadaloupensis,* by the aciculations found on the abdomen of *patelloides,* and by the naked and shining spot on the mesopleuron of *insolens.* The galls of these three varieties are, on the other hand, abun-

dantly distinct, furnishing another case of the value of physiologic data.

Our reasons for treating these insects as varieties of one species, rather than three distinct species, are the very nearly identical characters of the insects, their common hosts, and the fundamentally common plan of the galls. While these galls are so different in form, they are not as diverse as the galls of the several varieties of *Cynips echinus*, and the younger or more stunted galls of *patelloides* are quite like those of variety *guadaloupensis*.

Cynips guadaloupensis variety **guadaloupensis** (Fullaway) agamic form

Figures 27, 146, 168, 185

Callirhytis guadaloupensis Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 363, pl. 23 fig. 4. Fullaway, 1912, Journ. N.Y. Ent. Soc. 20: 278. Felt, 1918, N.Y. Mus. Bull. 200: 108. McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1): 39, pl. 2 fig. 5.

Acraspis guadaloupensis Weld, 1926 (in small part), Proc. U.S. Nat. Mus. 68 (10): 59.

FEMALE.—Head rufous and black; the mesopleuron almost entirely punctate and hairy; the abdomen smooth, naked, and without aciculations on segments three to six; the wings much reduced, about 0.62 of the body in length, falling distinctly short of the tip of the abdomen; length 2.5 mm. Figures 168, 185.

GALL.—Much flattened, circular, disk-like, up to 7.0 mm. in diameter and 1.2 mm. in height; the walls thick and the larval cell the only internal cavity; on leaves of *Quercus chrysolepis*. Figure 146.

RANGE.—California: Guadaloupe (R. W. Patterson; types). Santa Lucia Mts. (gall, acc. Weld 1926).

Probably occurring thruout the range of *Q. chrysolepis* in a more southern Coast Range area of California; perhaps extending thruout the mountains of California from the Sierra Madre north to the Oregon boundary. Figure 27.

TYPES.—Holotype and one paratype female and a gall at Stanford University. From Guadaloupe, California; galls December, 1906; adults January, 1907; *Q. chrysolepis;* R. W. Patterson collector.

The present re-descriptions are based on my recent studies of all the type material.

PARASITE.—*Eurytoma querci* Fullaway (acc. Fullaway 1912).

From the type galls which were collected in December, adults emerged indoors in January. This, and the data for the other species of the subgenus, leads us to expect normal emergence out-of-doors in December or early January.

This variety was described from a southern Coast Range area to which it may be restricted. On the other hand, galls indistinguishable from those of typical *guadaloupensis* are common in the mountains of more central California and in northern parts of that state, and two insects which I bred from Elk Mt., Lake County material, seem identical with the types of *guadaloupensis.* Perhaps all of the other more central California gall records listed in the introductory discussion of this species may apply to our present variety, but I prefer to withhold judgment until we can examine more insect material from the area. The Oregon and southern Arizona records for *guadaloupensis* will undoubtedly prove to represent distinct varieties.

The thin, flattened galls of the present variety are very different from the elongate, pouch-shaped galls of variety *insolens* and the usually bowl-shaped galls of *patelloides;* but some of the younger and stunted galls of *patelloides* are as thin as those of true *guadaloupensis.* In the latter case, the insects and the geographic ranges must be relied upon in making determinations. In addition, the galls of Fullaway's *pattersonae* (described in 1911, Ann. Amer. Ent. Soc. 4:352) are hardly distinguishable from thin galls of *guadaloupensis. Pattersonae,* however, represents an unrelated genus. The galls of *pattersonae* occur on the blue oak, *Q. Douglasii,* while all of the varieties of our present species are restricted to the canyon oaks, *Q. chrysolepis* and *Q. Wilcoxii.*

I am indebted to Dr. McCracken, of Stanford University, for the opportunity to study the types of this variety in connection with the present revision of *Cynips.* The holotype is light yellow rufous in color and appears to be not fully pigmented. The wings of both the holotype and the more normal (tho headless) paratype are distinctly shorter than the wings of either *insolens* or *patelloides,* but not as short as the wings of Weld's San Bernardino material of this species. Fullaway's statement that the areolet is "distinct" should not be taken to mean that it is open, for it is entirely closed in the type material.

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Cynips guadaloupensis variety **insolens** (Weld)
agamic form

Figures 27, 140-141, 167, 186

Acraspis insolens Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 59, fig. 42.

FEMALE.—Head brownish rufous; the mesopleuron with a shining, naked spot dorsally; the abdomen smooth, naked, and without aciculations on segments three to six; wings about 0.80 of the body in length, reaching about to the tip of the abdomen; length 2.0 to 2.6 mm. Figures 167, 186.

GALL.—Peculiarly pouch- or wedge-shaped; drawn to a blunt, cylindrical tip at the base, much compressed and concave on two broad sides; the sides with distinct rims, approaching each other basally but well separated apically, well rounded at the apex; up to 10.0 mm. in length, the broad sides up to 5.0 mm. wide and up to 4.0 mm. apart at the apex; the dimensions usually smaller than this; with the larval cell located near the apex of the gall and a large, elongate, cylindrical cavity lying between the cell and the base of the gall; on the under surfaces of leaves of *Quercus chrysolepis*. Figures 140-141.

RANGE.—California: Idyllwild (Weld; types). San Jacinto Mt. (galls, Kinsey).

Not known beyond a single locality in the San Jacinto Mountains, but possibly occurring thruout a southern Californian and Lower Californian area that reaches its northern limit in the San Jacinto Mountains. Figure 27.

TYPES.—5 females and galls. Holotype and one paratype female and galls in the U.S. National Museum (Cat. No. 27203); paratype females and galls in the American Museum of Natural History, the Field Museum, and Stanford University; paratype galls in the Philadelphia Academy and the Kinsey collection. From Idyllwild, California; gall September 21, 1922; females cut from galls November 11, 1922; *Q. chrysolepis;* Weld collector.

The holotype and three of the paratype insects and paratype galls have been used in making the present re-descriptions.

There are few cynipid galls more unusual in shape than the galls of this variety of guadaloupensis. Nevertheless, these show the internal structure typical in *Antron.*

Weld's material was collected on September 21 (in 1922), and living adults were cut out of the galls on November 11. The insects were all emerged from the galls which I collected on February 28 (in 1920). As with other agamic forms in this subgenus, the insects probably emerge out-of-doors in December or January.

Weld's type material and my own collections of *insolens* were made on the westward slopes of Taquitz Peak in the San Jacinto Mountains. No one, as far as I know, has found this gall at any other locality. We have collected enough Cynipidae from *Q. chrysolepis,* the host of *insolens,* to believe this variety does not occur north of the San Jacinto Mountains, but it is possible and probable that it occurs southward into Lower California. In numerous cases with the Cynipidae, the San Jacinto area is the meeting ground for the southern Sierran and Lower Californian faunas, and we are not surprised to find both varieties *patelloides* and *insolens* in this place, altho we still consider them geographic segregates of a single species.

Cynips guadaloupensis variety **patelloides** (Weld)

agamic form

Figures 27, 144-145, 170, 187, 192

?Andricus patelloides Trotter, 1910 (gall only), Boll. Lab. Zool. Portici 5: 106 fig. 6. Trotter, 1911 (gall only), Marcellia 10: 34 fig. "9" [= 6].

Acraspis guadaloupensis Weld, 1926 (Southern Sierran records), Proc. U.S. Nat. Mus. 68 (10) : 59.

Acraspis patelloides Weld, 1926 (in most part), Proc. U.S. Nat. Mus. 68 (10) : 60, fig. 43.

FEMALE.—Head bright brownish rufous, darker about the ocelli and on the median ridge; the mesopleuron entirely punctate and hairy; the abdomen with scattered aciculations on the sides, especially ventrally, on segments three to six; wings about 0.80 of the body in length, reaching about to the tip of the abdomen; length 2.0 to 2.9 mm. Figures 170, 187.

GALL.—Deep bowl-shaped, somewhat flattened basally, the sides steep but slightly flaring, the rim more or less circular, the top of the bowl solid, flat to concave; up to 13.0 mm. in diameter by 7.0 mm. high, usually smaller than this; with the larval cell centrally located at the top of the gall, the rest of the gall more or less spongy crystalline; on the under surfaces of leaves of *Quercus chrysolepis.* Figures 144-145, 192.

RANGE.—California: Idyllwild (Weld in U.S. Nat. Mus. and Kinsey coll.). San Jacinto Mountains and Pasadena (galls, Kinsey coll.). Camp Baldy in San Gabriel Mountains (gall, acc. Weld 1926). Mt. Lowe (gall, Silvestri in Kinsey coll.). Kern County (U.S.D.A. 5527, acc. Weld 1926). Sequoia National Park (types, Weld coll.). Yosemite (gall, Silvestri acc. Trotter 1910).

Probably restricted to a Southern Sierran area, at least from the San Jacinto Mountains to El Portal, except in the San Bernardino range. Figure 27.

TYPES.--Holotype and one paratype female in the U.S. National Museum. From Sequoia National Park, California; galls September 7, 1922; insects cut from galls November 10, 1922: *Q. chrysolepis;* Weld collector. Additional "paratypes," including insects and galls in the American Museum of Natural History, the Field Museum, the Philadelphia Academy, the Stanford University, and the Kinsey collections are entirely or in part from Idyllwild and from Kern County, California; these are of debatable value because they may represent distinct geographic varieties.

The holotype and the paratype from the same locality are the basis of the present re-descriptions.

The type galls of *patelloides* were collected on September 7 (1922) and galls in the National Museum were collected October 23 (1892). Live insects were cut from the type galls on November 10, and adults emerged from the other material cited on November 26. Normal emergence may be expected from late November, thru December, and into January. All of the insects had already emerged from the galls which I collected in the mountains north of Pasadena on February 7, and in the San Jacinto Mountains on February 28 (both in 1920).

This is not an uncommon gall in the southern Sierran system, and all of the deep, bowl-shaped galls of this species probably represent but a single variety that ranges in the mountains from the Merced River to the Sierra Madre and the San Jacinto ranges. This area in most cases has a uniform cynipid fauna. I have not seen Weld's material from Kyburz, in the central Sierras, but it probably represents a distinct variety, perhaps the same which I have represented by more mushroom-shaped galls from Colfax in that same part of the Sierras. I question whether a second variety of this species occurs within the range of *patelloides,* except in the San Jacinto Mountains where *insolens* (possibly a Lower Californian variety) is also represented. Weld's records of variety *guadaloupensis* from Idyllwild, the San Gabriel range, and the Sequoia National Park are in conflict with this opinion, and I have one gall from the San Jacinto Mountains and one from El Portal that I first determined as *guadaloupensis.* On the other hand, in my San Jacinto collection are galls that

show every gradation from specimens as thin as typical *guadaloupensis* to the thick galls of *patelloides*. I have three specimens of the Silvestri collection from Mt. Lowe, on which Trotter based his name *patelloides*, and they represent three degrees of thickness in the galls. Perhaps Weld's records for *guadaloupensis* in the Southern Sierras are based on young or stunted galls of *patelloides*, but this cannot be proved until we secure additional insect material from each type of gall.

As with other Cynipidae, the San Bernardino Mountains do not have the southern Sierran variety of the species. Both insects and galls of this undescribed variety are in Weld's collection, and galls are in my collection (W. Ebeling coll.), these galls being as thin as those of the typical variety *guadaloupensis*.

The galls of *Cynips echinus schulthessae*, from *Q. dumosa* in Lake County, California, are strikingly similar to the galls of *patelloides*.

Cynips (Antron) teres (Weld)

agamic forms

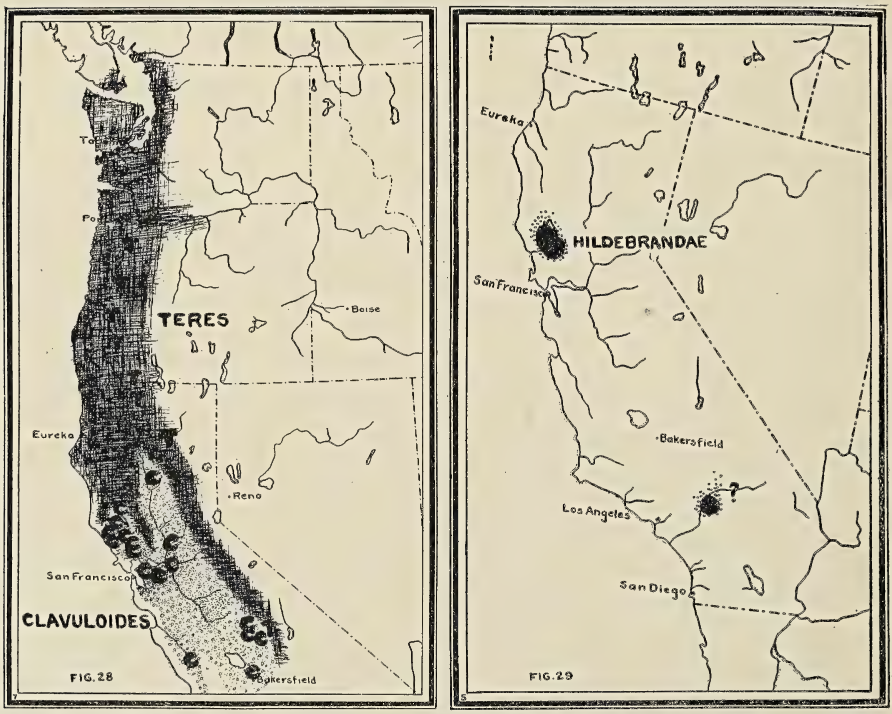
FEMALE.—Head as wide or wider than the thorax, brownish rufous, darker about the ocelli; thorax rufous, darker in places especially anteriorly between the parapsidal grooves and about the lateral lines; mesonotum finely punctate, smooth between the punctations, smoothest posteriorly, finely roughened anteriorly, irregularly coriaceous laterally; anterior parallel and lateral lines punctate, not well defined (long-winged insects), or anterior parallel and lateral lines lacking (short-winged insects); scutellum brownish rufous or darker, very finely rugose; abdomen dark brownish rufous to piceous; legs entirely rufous or darker; wings long (variety *clavuloides*) or very short and stubby (varities *hildebrandae* and *teres*); if the wings are long, the cubital cell has a large blotch basally and numerous spots apically, and the discoidal cell has a blotch basally but usually no spots; 1.2 to 2.5 mm. in length.

GALL.—Small, slender, stalked, swollen at the apex, resembling an inverted Indian club in shape. Up to 8.0 mm. in length and 2.7 mm. in width (near the apex). The stalk slender, strictly cylindrical except for a slight flare at the base, straight or bent, averaging 0.7 mm. in diameter, expanding gradually or abruptly into the swollen, spindle-shaped, or more spheroid body of the gall; the surface of the entire gall minutely granular, covered with a short, crystalline pubescence which more or less disappears with age; the young galls light, creamy

brown, becoming light reddish brown and finally dark brown. Internally rather hard, crystalline, the outer wall solid, rather thin, the stalk filled with a less solid crystalline mass, the body of the gall occupied mostly by the larval cell which has a distinct cell wall but is imbedded closely against the outer wall of the gall. Attached more or less at right angles; occurring singly, or a few scattered over the leaf, on the under surfaces of the leaves of *Quercus lobata, Q. garryana, Q. dumosa,* and *Q. durata.*

RANGE.—Probably from British Columbia to California, now known from western Oregon and more northern California southward in the mountains and the foothills to the southern end of the San Joaquin Valley. Figures 28, 29.

A *Quercus lobata* variety confined to the foothills rimming the central valleys of California, a *Q. garryana* variety occurring at higher elevations and in more northern localities in California and Oregon, and a *Q. dumosa* and *Q. durata* variety occurring in the Lake County area represent the described insects of this species.



FIGS. 28-29. VARIETIES OF CYNIPS TERES
On *Quercus lobata* and *Q. garryana* (fig. 28), and on *Q. dumosa* and relatives (fig. 29).

The galls of the three described varieties are so similar that their relation would never be questioned except that the variety *clavuloides* gives a normally long-winged insect and the varieties *teres* and *hildebrandae* give short-winged adults with reduced thoraces and swollen abdomens. Most authors have considered the first a true *Cynips* (= *Dryophanta*), but Weld considered *teres* a *Xanthoteras* related to the wingless *forticornis* of the eastern United States. In Part I of the present study we have presented our reasons (pp. 25 to 36) for recognizing these diverse insects as varieties of one species.

Cynips teres variety **clavuloides**, new name*

agamic form

Figures 28, 142-143, 164, 171, 188

——[no name] Kellogg, 1904, Amer. Ins., fig. 659.

Dryophanta clavula Beutenmüller, 1911, Ent. News 22: 67. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 347, pl. 13 fig. 7. Felt, 1918, N.Y. Mus. Bull. 200: 106, fig. 99(7). McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1) : 11.

Diplolepis clavula Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 337. Weld, 1926, Proc. U.S.Nat. Mus. 68 (10) : 24.

——[no name] Leach, 1923, Oakland (Calif.) Tribune Mag., May 6, 1923: 11, fig.

[NOT *Cynips clavula* Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 351].

FEMALE.—Head about as wide as the thorax; thorax of normal size, rather slenderly robust, longer than high, almost twice as long as wide; parapsidal grooves distinct; anterior parallel lines of moderate width, distinct, broader posteriorly, not widely separated; lateral lines moderately wide, smooth and naked, long; scutellum of normal size, distinctly longer than wide, not particularly broad, dorsally raised along a median line, the foveal groove shallow, narrow, not divided but narrowest at the mid-point; abdomen rather slender, about twice as long as high, very much produced dorsally, the second segment elongated tongue-shaped, covering nearly three-quarters of the abdomen; wings long, about 1.6 times the body length; the first abscissa of the radius with a distinct infuscation, areolet of moderate size or smaller, more or less infuscated; the cubital cell with a rather large, smoky brown patch near its base and with 7 to 12 distinct spots spread over the rest of the cell, some of these spots sometimes tending to fuse; a lighter smoky patch at the base of the discoidal cell; similar smoky patches where the

* In accordance with the recommendation of the International Code, I have offered Mr. Beutenmüller the opportunity to re-name this insect. Under date of August 24, 1929, he writes me as follows: "My D. clavula is not congeneric with C. clavula O. S. and I do not want to make the change, as mostly all of your work is synthetic and of no value. Yours truly, W. Beutenmüller."

cubitus meets the basalis and at the break in the discoidal vein; length 1.5 to 2.1 mm. Figures 164, 171, 188.

GALLS.—Slender, long, up to 8.0 mm. in length, the stalk nearly twice the length of the swollen portion of the gall, the swollen portion slender to broad spindle-shaped, drawn out into a slender point apically; on leaves of *Quercus lobata.* Figures 142-143.

RANGE.—California: Yorkville and Clear Lake (galls, Leach in Kinsey coll.). Kelseyville (P. Schulthess in Kinsey coll.). Sonoma and Napa Counties (types; Koebele coll.). Napa (galls, Leach in Kinsey coll.; also J. C. Bradley acc. Weld 1926). Sacramento (in Mus. Comp. Zoöl.). Chico, Calistoga, Stockton, Kaweah, and Levee (galls, acc. Weld 1926). Concord (C. T. Dobbs in Kinsey coll.). Mt. Diablo (Leach in Kinsey coll.). Palo Alto (Wiltz in Stanf. Univ.). Sierra foothills east of Dinuba, and St. Johns River near Klink (L. H. Powell in Kinsey coll.).

Confined perhaps to a narrow area rimming the Central Valleys of California, probably limited to *Q. lobata.* Figure 28.

TYPES.—12 females and galls studied by Beutenmüller; additional material from the same collection more recently recovered in the U.S. National Museum. Holotype and paratype females and galls at the U.S. National Museum; paratypes or material from the same lot at the Museum of Comparative Zoölogy, in the Beutenmüller collection (?), and in the Kinsey collection. From Sonoma and Napa Counties, California; *Q. lobata* (!); A. Koebele collector.

The holotype and most of the paratype material was examined in making the present re-descriptions.

This distinctive gall is never abundant, but it is usually included in collections made in the autumn on the Valley white oak of the foothills rimming the Central Valleys of California. The young galls begin development in August (acc. Weld), and are fully grown by the middle of September (September 12 in 1921 at Concord). Galls collected as early as October 4 (in 1925 at Kelseyville) had very large larvae in them. Most of the insects I have bred have emerged during the first half of January, but the Kelseyville material emerged between January 29 and February 5, 1926. McCracken and Egbert record January emergence for indoor breeding.

All of the material I have examined has come from *Q. lobata,* and if this or a related variety ever occurs on *Q. Douglasii* it would appear to be rare. In the original description Beutenmüller's host record ran "a species of white oak (probably *Quercus douglasi*)." He corrected this to "*Quercus lobata*" in his subsequent treatment of the genus *Dryophanta.*

I do not know the basis of the McCracken and Egbert record for *Q. Douglasii.*

While we may yet find this variety in the Central Valley proper, it is noteworthy that up to date the only records are from the foothills rimming the Valleys from their northern to their southern limits, a peculiarly outlined area that has other insects and plants confined to it.

The figure in Kellogg's American Insects, and galls in my collection taken east of Dinuba, show larger, more swollen apices than any of the galls from other parts of California. The insects from the Dinuba material similarly average larger.

Upon transferring this insect to the genus *Cynips*, Beutenmüller's name of *clavula,* being pre-occupied, gives way to *teres* for the species and a new name for the variety.

There are galls of this species in the Ashmead collection at the National Museum labelled types of *Andricus claviger* Ashmead. This is a confusion of material, for the holotype insect of *claviger* represents a Florida species of an entirely different genus.

Cynips teres variety **hildebrandae,** new variety

agamic form

Figures 29, 162, 173, 189, 196

FEMALE.—Head and thorax rather dark rufous, the scutellum darker, the abdomen entirely black including the hypopygium; the legs entirely dark brownish rufous; the head wider than the thorax, the thorax small, no longer than high, only half again as long as wide; parapsidal grooves fine, more or less indistinct in places; anterior parallel and lateral lines more or less lacking; scutellum small, a little longer than wide, quite flattened, broadly depressed anteriorly but with no other indication of a foveal groove; abdomen enlarged, not much longer than high, the second segment short tongue-shaped, covering little more than half the whole area; wings much reduced, about 0.52 of the body in length, reaching half way along the abdomen, distinctly longer than in the variety *teres;* the venation reduced but complete from the base of the wing and distally to include one-third of the apical portion of the subcosta, of the second abscissa of the radius, and of the cubitus; length 2.0 to 2.2 mm. Figures 162, 173, 189.

GALL.—Rather short, up to 6.5 mm. in length, the stalk rather slender but not long, the swollen portion spherical, rounded at the apex; on leaves of *Quercus dumosa* and *Q. durata.* Figure 196.

RANGE.—California: 7 miles southeast of Kelseyville (galls, Hildebrand in Kinsey coll.). Lower Lake (in Kinsey coll.). Seigler Springs (*Q. durata*, Hildebrand coll.; types). Scott Valley in Lake County (*Q. dumosa*, Schulthess in Kinsey coll.). Cobb Mountain in Lake County (*Q. durata*, Schulthess in Kinsey coll.). Napa County 12 miles southeast of Middletown (*Q. durata*, galls, Schulthess and Hildebrand in Kinsey coll.). North of Beaumont (gall, W. Ebeling in Kinsey coll.).

Probably confined to *Q. dumosa* and *Q. durata* in a limited area of California which includes Lake County and northern Napa County; possibly extending southward in a narrow rim about the Great Valley. Figure 29.

TYPES.—2 females and 3 galls in the Kinsey collection. Labelled Seigler Springs, California; galls October 1, 1927; insects December 23, 1927; *Q. durata;* Hildebrand collector.

This scrub oak (*Q. dumosa* and *Q. durata*) insect is close to Weld's *teres* which is probably confined to the Oregon oak, *Q. garryana*. In *hildebrandae* the color is darker brown-rufous, especially on the legs and the hypopygium, and the wings are distinctly longer than in *teres*. *Hildebrandae* and *Cynips mellea bifurca* are the only short-winged cynipids I know which show remnants of the venation in the apical half of the wing without showing the complete even tho dwarfed venation of that area.

For the past two years Miss Dorothy Hildebrand and Miss Pauline Schulthess, both of Kelseyville in Lake County, have been finding this scrub oak gall fully matured by the middle of September. It probably begins development as early as July. A single gall which I have from *Q. dumosa* in the San Bernardino Mountains north of Beaumont was nearly full-sized on July 1 (1928), but this specimen may represent a variety distinct from *hildebrandae*. Insects emerged naturally from the type galls out-of-doors (at Bloomington, Indiana) on December 23 (1927).

I am naming this species for Miss Hildebrand, not only because she was the collector of the type material, but also in appreciation of the thorough piece of work which she and Miss Schulthess have contributed in collecting the entire cynipid fauna of that interesting and in many ways unique area centering in Lake County, California.

Cynips teres variety **teres** (Weld)

agamic form

Figures 28, 172, 190

Xanthoteras teres Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 52, fig. 40.

FEMALE.—Head and thorax, including the scutellum, rather bright rufous, darker rufous in only a few places; the abdomen mostly black but bright rufous about the hypopygium, the legs largely bright rufous; head wider than the thorax; the thorax small, no longer than high, only half again as long as wide; parapsidal grooves very fine, more or less indistinct in places; the anterior parallel and lateral lines more or less obliterated; the scutellum small, a little longer than wide, flattened, depressed anteriorly but with no other indication of a foveal groove; abdomen much enlarged, half again as long as high, the second segment short tongue-shaped, covering little more than half the whole area; wings much reduced, about 0.36 of the body in length, hardly longer than the thorax, with only the proximate remnants of the subcosta and anal vein and the basalis; length 1.2 to 2.5 mm. Figures 172, 190.

GALL.—Shorter, more robust, up to 6. mm. in length, the stalk hardly longer than the swollen portion of the gall, the swollen portion quite spherical, well rounded at the apex; on leaves of *Quercus garryana* and its varieties.

RANGE.—Oregon: Salem, Cottage Grove, Oakland, Wolf Creek, McLeod, and Siskiyou (galls, acc. Weld 1926).

California: Scott Bar and Fort Jones (galls, acc. Weld 1926). Yreka (galls, Kinsey coll.). Pit River, and Cow Creek near Millville (galls, Leach in Kinsey coll.). At about 4000 ft. in Sequoia National Forest (above Cedar Creek Checking Station; types, Weld coll.).

Probably confined to higher elevations in Central California, and to more northern California and adjacent Oregon, wherever *Q. garryana* and its varieties occur. The Oregon records north of the Rogue River may represent a distinct variety. Figure 28.

TYPES.—6 females and 11 galls. Holotype and paratypes in the U.S. National Museum, number 27200; paratypes in the American Museum of Natural History, the Field Museum, Stanford University, and in the Kinsey collection. Paratype gall in the Philadelphia Academy. From Sequoia National Park, California, along the Giant Forest road above the Cedar Creek checking station; galls September 8, 1922, adults cut out November 13, 1922; *Q. garryana semota;* L. H. Weld collector.

The holotype and four of the paratypes were used in making the above re-descriptions.

This variety is as yet known only from galls and insects of the type collection, and from similar galls collected widely at higher elevations and more northern localities in California

and western Oregon. It is confined to the Oregon white oak and its varieties. Experience with many other organisms, both plant and animal, might lead us to expect to find a distinct variety represented by the more northern Oregon records which are now based on galls alone.

Full-sized galls were collected by Mr. Leach on July 21 (in 1924 at Millville), and Weld also records fully-formed galls late in July. The type insects were alive in the galls from which they were cut on November 13. They might be expected to emerge in late December or January, the normal dates for emergence in this genus.

Cynips (Antron?) pulchella (Beutenmüller)

bisexual form

Dryophanta pulchella Beutenmüller, 1911, Ent. News 22: 357. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 355. Felt, 1918, N.Y. Mus. Bull. 200: 120. McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1) : 13.

ORIGINAL DESCRIPTION. Beutenmüller, 1911, Ent. News 22: 357.

Female.—Head rufous or pitchy brown, finely punctate, median ridge rather broad. Antennae 14-jointed, dark brown, first and second joints yellowish brown. Thorax dark reddish brown or black, smooth and shining. Parapsidal grooves sharply defined with the margins rounded; they are widely separated anteriorly and very close together at the scutellum. Median groove broad anteriorly and gradually becoming narrower and very fine at the scutellum. Anterior parallel lines and lateral grooves wanting. Pleurae punctate with a large, smooth, glossy area. Scutellum dark rufous or black, rugose, with two large depressions or foveae at the base, separated by a fine carina. Abdomen rufous, smooth and shining. Legs rufous. Wing long, hyaline with a number of large brown clouds and patches of different sizes. Veins heavy, brown and infuscated. Areolot small, Cubitus continuous to the first cross-vein. Radial area open, radial vein curved and running outwardly for a short distance below the costal margin. Length, 3—3.50 mm.

Habitat: Catalina Island, California, (C. F. Baker) ; Hood River, Oregon. June 20th.

In the specimen from Oregon the thorax is black, otherwise it does not differ from the form with the red thorax. It is a beautiful species and may be readily known by the large spots and cloud on the fore wings. The male and gall are unknown.

TYPES. In the Beutenmüller collection. Not available for study.

No material of this insect has been available for the present study. From the original description *pulchella* would appear to be a true *Cynips.* The naked abdomen, blotched and spotted wings, and Pacific Coast distribution suggest that the subgeneric position is in *Antron.* All of the characters of the insect and the June collection would identify this as a bisexual form, and if it is a true *Antron* this must be the bisexual generation of some variety of *C. teres* or *C. guadaloupensis.* The bisexual forms of *C. echinus* are known to differ in detail from *pulchella.* The naïve admission that the Oregon specimen has a black thorax while the Catalina Island specimen has a red thorax is, of course, in accord with our knowledge that southern Californian cynipids may be represented by closely related but not identical varieties in northern Oregon. Until someone obtains access to the Beutenmüller collection, it will be impossible to determine which of the two type specimens deserves the name *pulchella* and which represents the unnamed variety.

Pulchella has not been counted in the statistics given in this paper, for if it proves the bisexual generation of some described, agamic form of *Antron,* it will not alter the total number of varieties known in the genus.

Cynips subgenus **Besbicus**, new subgenus agamic forms

Holcaspis of one assignment (Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 43).
Amphibolips of one assignment (Trotter, 1910, Boll. Lab. Portici 5: 101).
Cynips Fullaway, 1911 (in part), Ann. Ent. Soc. Amer. 4: 343-345. McCracken & Egbert, 1922, Stanford Univ. Publ. 3 (1): 19-20. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 62-64. Also of most other American authors.
Dryophanta Beutenmüller, 1911 (in part), Bull. Amer. Mus. Nat. Hist. 30: 346.

FEMALE.—The cheeks distinctly enlarged behind the eyes; antennae unusually long and slender, with 14 (or 15) segments; the thorax large, sometimes heavy; parapsidal grooves distinctly continuous; median groove lacking or barely indicated posteriorly; mesopleuron entirely punctate; abdomen naked only dorsally, the lateral surfaces of the second to fifth segments always finely punctate and well-coated with appressed hairs; hypopygial spine remarkably large, nearly as high as long, with the ventral tip blunt, with large, dorsal projections that extend nearly as far as the ventral tip or beyond it; tarsal claws large, heavy, strongly toothed; wings always long, about 1.50 times the body length, the second abscissa curved only toward the tip, ending in a triangulate expansion; the radial cell rather long, of moderate width; areolet large to very large; the cubital and discoidal cells with faint, smoky patches, the cubital cell with numerous dark spots, the spots rather regularly distributed over the cell, rarely tending to fuse; the discoidal cell with spots which may be obscure in some individuals; usually robust insects 2.5 to 5.0 mm. in length.

GALL.—Of diverse form and structure; fundamentally spherical, in one species *(maculosa)* drawn out to a short gourd-shape, in another *(heldae)* with irregular ridges and projections distorting the surface; moderately small to large galls; thin-shelled to thick-walled; with a distinct larval cell that is held in place by silky, radiating fibers (in *mirabilis, maculosa,* and young *multipunctata*) or closely embedded in solid, crystalline masses that fill most of the gall (*heldae* and old *multipunctata*). Attached singly or (more often) clustered, on the leaf veins, petioles, or (in *heldae* and *multipunctata*) young twigs of Pacific Coast white oaks (not including the *Q. chrysolepis* group).

RANGE.—Confined to a more northern Pacific Coast area; known from Kern County, California, to British Columbia, probably extending to the northern limit of *Quercus garryana* in British Columbia. Figure 30.

SUBGENOTYPE.—*Cynips multipunctata conspicua,* new variety. Present designation.

This is a northern Pacific Coast subgenus of *Cynips*, the only one represented north of the California-Oregon boundary. Of the four species in the group, all are known from the Mendocino-Lake County area, only one (*multipunctata*) is found in the Central Valley, and only one (*mirabilis*) is known to extend north of California. There are no records of any species occurring south of Kern County, in what is technically Southern California, even tho *Q. dumosa*, the host of one of the species in the north, is the white oak of lower elevations in Southern California.

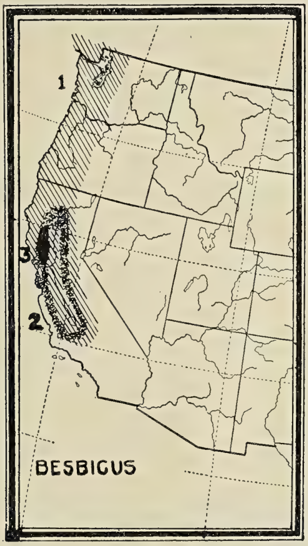


FIG. 30. KNOWN RANGE, SUBGENUS BESBICUS
Shading and figures indicate number of species known from each area.

In numerous respects, including the 14-15 segmented antennae, the remarkably large hypopygial spine, and the entirely hairy abdomen, *Besbicus* is distinct from any other group of *Cynips*; and yet it agrees with *Cynips folii* (the genotype) in many respects.

Besbicus is known from but 3 species, representing 8 varieties. Two of these were described in 1911, one in 1922, one in 1926, and the remaining four in the present paper. The subgenus is of such recent discovery that our knowledge of it may be quite incomplete.

The described species represent two groups. The insects of *heldae* and *multipunctata* are not distinguishable, and altho

the galls of the two are different enough, *heldae* appears to represent the *multipunctata* stock on *Q. lobata* in the Lake County area. The galls of both occur on the petioles and young twigs as well as on the leaves of the oaks; all of the other known *Cynips* galls are confined to the leaf veins of their hosts. The insects of *maculosa* and *mirabilis* are similarly close, while the galls differ considerably. It must be concluded that distinct lines of origin and evolution are represented by these two groups. The species furnish striking instances of the importance of physiologic characters in taxonomy.

The galls of *Besbicus* are rather more diverse than is the rule in cynipid genera and subgenera. In form the four species bear little resemblance; in internal structure they agree in having all five of the fundamental gall layers; nutritive, protective, parenchyma, collenchyma, and epidermal; but *mirabilis* differs from the others in having the parenchyma remarkably developed into a fibrous mass which holds the larval cell centrally in the gall.

The galls of the agamic forms begin development in midsummer. The agamic adults emerge from November to February, earlier furthest north. No bisexual form of the present subgenus has as yet been recognized.

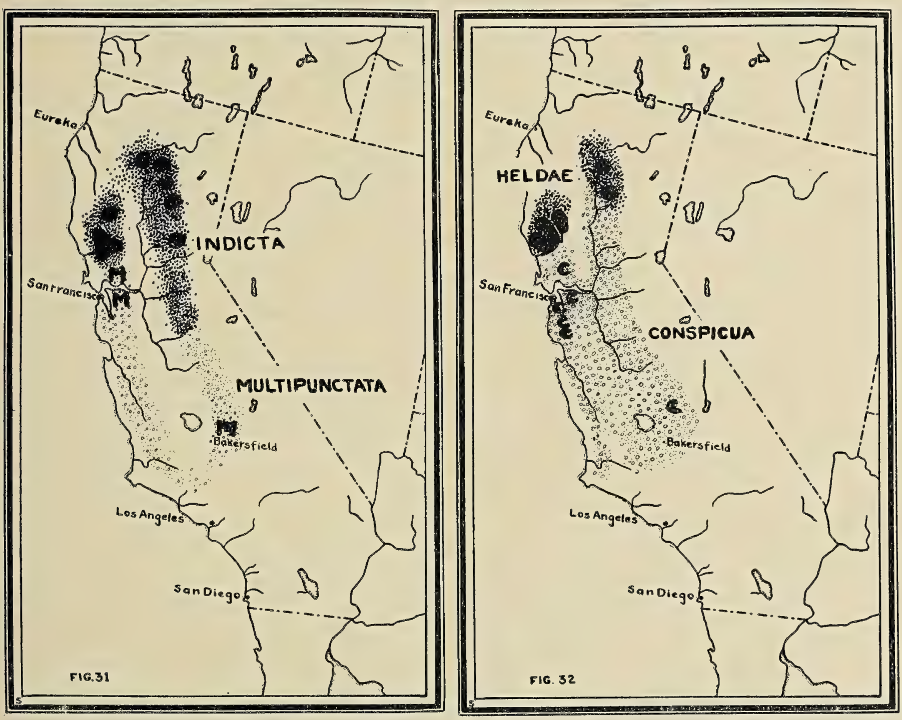
Cynips (Besbicus) multipunctata (Beutenmüller)

agamic forms

FEMALE.—Head no narrower than the thorax, dark rufous, black over a large part of the face medianly and about the mouth; the fourth antennal segment of only moderate length; thorax large but not as heavy as in *mirabilis,* hardly as high as long, dark rufous with considerable black over the mesonotum including the scutellum; anterior parallel lines barely indicated; scutellum of moderate width, largely smooth, sparsely punctate, anteriorly depressed, the foveal depression broad, moderately deep, and with or without an indistinct division into foveae; abdomen dark rufous to blackish, generally darker dorsally; dorsal projections of the hypopygial spine well developed but not as long as in *mirabilis* and *maculosa;* the cubital cell with 15 to 20 spots, the discoidal with 2 to 16 spots; length 2.5 to 4.0 mm., averaging nearer 2.5 mm.

GALL.—Spherical, the surface much distorted in variety *heldae;* more or less solid, largely naked, attached to the leaves or stems. Up to 10. mm. in diameter, averaging nearer 7.0 mm., the sphere more or

less drawn out and then flattened at the base where it is attached by a wedge-shaped point that is inserted into the leaf vein, petiole, or twig, galls from compacted clusters often flattened on the sides; at first light green in color, brown or gray when mature, more or less smooth, mature galls microscopically roughened and irregularly reticulated with blunt papillae and raised ridges, dried galls often wrinkled; the surface microscopically puberulent or finely and sparsely pubescent with stellate and sometimes longer hairs. Internally more or less compact fibrous, the area directly under the epidermis and about the larval cell crystalline and compact, the intervening space filled with much branched, more or



FIGS. 31-32. VARIETIES OF CYNIPS MULTIPUNCTATA
On *Quercus douglasii* (fig. 31), and on *Q. lobata* (fig. 32). Showing host and geographic isolation.

less compacted, silky or crystalline fibers; the larval cell large, oval to round, up to 4.0 mm. in length, placed nearer the base of the gall, the wall of the cell hardly distinct, not at all separable. On the leaves, attached to the veins, on the petioles, or young twigs of *Quercus lobata* and *Q. douglasii.*

RANGE.—California, thruout the Great Valley and adjacent areas, at least from Shasta to Kern Counties, probably wherever *Q. lobata* and *Q. douglasii* occur.

The galls of this species are common and in places abundant in the fall in the Great Valley of California. They begin development in the mid-summer, soon maturing. The larvae become fully grown sometime later and transform into adults which emerge in November or December, or in some cases not until after the middle of January. The old galls fall with the leaves or stay attached to the twigs for a while, but I found no remnants of the galls, except for a single specimen, in collecting in February and March in the range of this species.

The *Q. lobata* and *Q. Douglasii* varieties of this species are easily distinguished by the insect characters, the surfaces, interior structures and attachments of the galls, and by the host relations. The two varieties which occur on *Q. Douglasii* are not to be distinguished by the gall characters, altho the insects are different enough. The two on *Q. lobata* have insects that are difficult to separate but galls so unique that they have previously been considered distinct species. The published records for the occurrence of any of these insects on more than one species of oak are based on mis-determinations, as noted under *conspicua*.

Cynips multipunctata variety **multipunctata** (Beutenmüller) agamic form

Figures 31, 203-204, 217

Dryophanta multipunctata Beutenmüller, 1911, Ent. News, 22: 67. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 346, pl. 12 fig. 5. Felt, 1918, N.Y. Mus. Bull. 200: 114, fig. 97 (5).

FEMALE.—Median groove practically lacking; scutellum anteriorly almost as smooth as the mesonotum; foveal groove indistinct, without a trace of division into foveae; wing veins and infuscations generally heavier and the spotting heavier than in *conspicua,* less heavy than in *indicta;* the discoidal cell with usually 6 to 10 spots; the cubital cell heavily spotted, the spots tending to coalesce; the radial cell with or without spots; length 2.7 to 3.7 mm., averaging smaller than either of the other varieties. Figure 217.

GALL.—Indistinguishable from that of variety *indicta,* unless averaging larger. Green when young, becoming light and then dirty gray in color; appearing finely pubescent, in reality microscopically set with fine papillae and narrow, reticulated ridges, with only a scant pubescence of stellate and longer hairs, these wearing off in time; internally with

finer, more silky, less compacted fibers between the outside wall and the larval cell, the cell in consequence easily broken from its position; occurring singly, rarely in small, not compacted clusters, fastened to the veins, on the under surfaces of leaves of *Quercus Douglasii.* Figures 203-204.

RANGE.—California: Kern County (types in U.S. Nat. Mus.). Diablo and Napa (F. A. Leach in Kinsey coll.).

Probably thruout the more southern range of *Q. Douglasii.* Figure 31.

TYPES.—One female, one gall at the U.S. National Museum; another female and gall not located. From Kern County, California; December 6, 1892.

The National Museum types were examined in making the present re-descriptions.

This variety is restricted to the blue oak, *Q. Douglasii,* and has thus far been found only on the leaves. Beutenmüller's original host record was a "species of oak," changed in his revision of the genus to "a species of white oak." Without further data, Felt took this to mean *Q. lobata,* and McCracken and Egbert give this as the only host. The leaf with the type gall is, however, distinctly that of *Q. Douglasii,* and I have never seen specimens from any other oak and feel sure that the *lobata* records are unfounded.

Leach collected galls in the latter half of July at Diablo. All of the galls collected after the first week in December have shown the emergence holes of the gall maker, and have never given me further adults. It is, however, to be questioned whether emergence is normally as early as this since the other varieties of the species emerge later in December and in January.

The holotype female of *multipunctata* at the U.S. National Museum is a small, broken, and not deeply pigmented specimen that looks as if it might have been cut from an old gall. It is smaller, with the body lighter in color and the wings less heavily spotted than specimens I have from Diablo; but these differences might well be due to the immature character of the holotype female, and certainly it is closer to the Diablo material than to *indicta,* the other variety known from *Q. Douglasii.*

Cynips multipunctata variety **indicta,** new variety agamic form

Figures 31, 198, 201-202, 212, 218

FEMALE.—Median groove practically lacking; scutellum anteriorly almost as smooth as the mesonotum; foveal groove well defined, with a suggestion of a division into foveae; wing veins and infuscations generally heavier than in *conspicua;* wings more heavily spotted than in the other varieties, most of the spots more elongate and more often tending to fuse; the cubital cell heavily spotted; the radial cell usually with 3 or more spots; the discoidal cell with 12 to 18 distinct spots; the length 3.5 to 4.5 mm., averaging larger than the other varieties. Figures 212, 218.

GALL.—Indistinguishable from that of variety *multipunctata (q.v.),* unless averaging smaller; mature galls becoming light and then dirty gray in color; internally with rather fine, silky fibers; on the under surfaces of leaves of *Quercus Douglasii.* Figures 198, 201-202.

RANGE.—California: South Cow Creek in Shasta County, and Inskip (galls, F. A. Leach in Kinsey coll.). Redding (Kinsey coll. and F. A. Leach in Kinsey coll.). Battle Creek at 2000 ft. (F. A. Leach in Kinsey coll.). Colfax (E. R. Leach in Kinsey coll.). Kelseyville (types, P. Schulthess in Kinsey coll.). 7 miles southeast of Kelseyville; Lower Lake (D. Hildebrand in Kinsey coll.). Cobb Mountain and the south side of Bartlett Mountain in Lake County (P. Schulthess in Kinsey coll.).

Probably thruout the more northern range, or the altitudinally higher range of *Q. Douglasii.* Figure 31.

TYPES.—10 females, many galls. Holotype female and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History and the U.S. National Museum. Galls at Stanford University, and the California Academy. Labelled Kelseyville, California; galls September 20, 1925, and September 26, 1926; *Q. Douglasii;* P. Schulthess collector.

This is the more northern variety on the blue oak, *Q. Douglasii.* The gall is hardly distinguishable from that of *multipunctata,* the more southern variety on the same oak, but the insect is quite distinct. The material from Kelseyville and points north of there is typical *indicta;* the material from seven miles south of Kelseyville and from other points in the southern portion of Lake County is intermediate between *indicta* and *multipunctata,* and not determinable as one or the other variety. The material from Napa County clearly represents variety *multipunctata.*

Miss Schulthess, who collected the type material, found full-sized but not yet fully developed galls as early as July 15

(1925 at Kelseyville). Mr. Leach has collected more mature galls at later dates in July, but none of the collections made before the first of September contained larvae large enough to be bred. I have bred adults (out-of-doors at Bloomington, Indiana) on December 23 and January 8, 12, and 20, and still later in January (1926-28). From one lot of 52 galls, 7 contained gall makers, and all the others were parasitized.

Cynips multipunctata variety **conspicua**, new variety agamic form

Figures 32, 203-204, 211, 219

——[no name] Kellogg, 1904 (gall only), Amer. Ins.: fig. 660.
Cynips multipunctata err. det. Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 343, 366, 368. Felt, 1918, N.Y. Mus. Bull. 200: 66. McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1): 20, 49, 51, 65.

FEMALE.—Nearly identical with variety *heldae (q.v.)*. Median groove shallow and indefinite but often evident for more than half the length of the mesonotum; scutellum anteriorly finely rugose, grading directly into the roughened surface of the undivided foveal depression; wing veins and infuscations not as heavy as in variety *multipunctata,* nor the wings as heavily spotted as in either of the other varieties; cubital cell well spotted but not as heavily or as abundantly as in *multipunctata,* the spots rarely coalescing; the radial cell usually unspotted or with only one or two small spots; the discoidal cell with not more than two or three spots; length 2.5 to 4.5 mm., averaging larger than *multipunctata.* Figures 211, 219.

GALL.—Green when young, becoming light and then dark brown in color, appearing mostly smooth and naked, with only a sparse, microscopic puberulence, the microscopic ridges relatively broad; internally more or less solid with compacted, crystalline fibers; occurring singly or often in more or less compacted clusters of up to a dozen galls, on the veins on the under or upper surfaces of the leaves, on the petioles, or on the young twigs of *Quercus lobata.* Figures 203-204.

RANGE.—California: Palo Alto (Wiltz coll. in Stanford Univ.). Cupertino (acc. Fullaway 1911). Diablo (F. A. Leach in Kinsey coll.). Napa (types, F. A. Leach in Kinsey coll.). Redwood City (C. T. Dodds in Kinsey coll.). Contra Costa County (galls, E. C. Van Dyke in Kinsey coll.). Klink (galls, L. H. Powell in Kinsey coll.).

Probably wherever *Q. lobata* occurs thruout the Great Valley of California. Replaced in the Mendocino-Lake County area by variety *heldae.* Figure 32.

TYPES.—27 females, many galls. Holotype female, paratype females, and galls in the Kinsey collection. Paratype females and galls at Stanford University, the Museum of Comparative Zoölogy, the American Museum of Natural History, and the U.S. National Museum.

Labelled Napa, California; galls October 30, 1923; *Q. lobata;* F. A. Leach collector.

INQUILINES.—*Synergus dimorphus* Osten Sacken (acc. Fullaway 1911. Doubtful det.). Emerges in March (acc. McCracken and Egbert 1922).

S. ochreus Fullaway (acc. Fullaway 1911).

This variety is restricted to the valley white oak, *Q. lobata.* The galls occur in about equal abundance on the leaves, the petioles, and the young twigs. They probably appear sometime in July. Mr. Leach has collected full-sized but succulent galls at Diablo as early as August 13 and 26 (1926), and more mature galls on September 16 (in 1924). On November 26 (in 1922 at Diablo) there were large larvae in the galls. Galls collected at the same locality as late as December 18 still contained mature adults which emerged soon after that date, tho other records indicate that emergence sometimes occurs late in November or earlier in December.

Fullaway recorded two species of *Synergus* bred from this gall (see above). Of all the material I have handled, perhaps 80 per cent of the galls were inhabited by parasites or inquilines, the latter not always destructive to the gall maker larvae.

Fullaway first described this variety from Stanford University material which Beutenmüller had determined as *multipunctata.* Fullaway noted the distinctive character of the gall, its location and host, the characteristic spotting of the wings, and the size of the insect, concluding that Beutenmüller's "specimens are obviously different from mine," but neglecting to give this insect a new name. Felt listed the two as distinct, but under one name. McCracken and Egbert repeated Fullaway's suggestion without giving separate descriptions of the two. Dr. McCracken has kindly forwarded the Stanford material for my examination, and there is no question that it represents the present variety.

Cynips multipunctata variety **heldae** Fullaway
agamic form

Figures 32, 195, 205-206, 213, 220

Cynips heldae Fullaway, 1911, Ann. Ent. Soc. Amer. 4:345, pl. 23 fig. 2. Felt, 1918, N.Y. Mus. Bull. 200: 106. McCracken and Egbert, 1922, Stanford Univ. Publ. 3 (1) : 20. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10) : 62.

FEMALE.—Apparently identical with the female of variety *conspicua, q.v.* Figures 213, 220.

GALL.—Generally spherical (as seen in cross-section), but so distorted with peculiarly irregular ridges and spines on the surface as to appear very irregular, even cubical; up to 10.0 mm. in diameter, completely covered with an irregular, often twisted mass of broad, blunt spines which are usually flattened and often ridged; the surface of the gall smooth, naked, with a microscopic scurf on the younger galls, this scurf more or less lost on the older galls; young (but fully grown) galls light reddish brown in color, often lighter gray because of the scurf, the older galls dark, dirty brown. Internally solid with a compact, crystalline substance which is not as hard as in *Cynips echinus* and which contains more compacted, branched fibers; the larval cell large, up to 4.0 mm. in diameter, central or asymmetrically placed. Occurring singly or in compacted, distorted masses of as many as 8 galls, on the twigs (terminally or laterally), on the leaf petioles, or on the veins on the upper or under surfaces of the leaves of *Quercus lobata.* Figures 195, 205-206.

RANGE.—California: Ukiah (types, M. Held coll.). Yorkville (F. A. Leach and R. S. Walker in Kinsey coll.). Cloverdale (F. A. Leach in Kinsey coll.). Kelseyville (P. Schulthess in Kinsey coll.). Clear Lake (galls, F. A. Leach in Kinsey coll.). Lakeport, Bartlett Springs and Chico (galls, acc. Weld 1926). Cottonwood (A. W. Gambs in U.S. Nat. Mus.).

Probably confined to a limited area including parts of Mendocino, Lake, and northern Sonoma Counties, and rimming at least the northern part of the Sacramento Valley. Figure 32.

TYPES.—Holotype and one paratype female and galls at Stanford University, one gall in the Kinsey collection; two galls and one adult cut from a type gall in the U.S. National Museum. From Ukiah, California; gall November 16, 1906; insects January 22, 1907; *Q. lobata;* M. Held collector.

The present re-descriptions are based on the paratype material in the National Museum and Kinsey collections, compared with several series from Mendocino and Lake Counties.

The remarkable gall of this species is, apparently, not rare in the Mendocino-Lake County area, but it is as far as we know confined to that part of California. While often occurring on the twigs of the Valley oak, one of the two instances of a true *Cynips* gall in this location, it is by no means confined to the twigs as Weld suggests, for I have specimens from petioles and from leaf veins, both on the upper and under surfaces of the leaf. Oviposition is evidently not so unlike oviposition with other agamic forms of *Cynips.*

Weld records fully grown galls containing immature insects as early as August. Thru the courtesy of Miss Schulthess

and Mr. Leach, I have series of the galls and of the adults from a number of localities. Galls collected at Kelseyville on September 25 (in 1926) were fully grown but contained very small larvae. The galls collected at the same locality on October 4 (in 1925) contained larvae that were still not mature. The galls collected at Yorkville on October 22 and at Cloverdale on October 26 (both in 1922) contained live adults in November. Adults emerged from Kelseyville material, bred at Bloomington, Indiana, from January 22 to February 5, 1926, at a season when we were having freezing temperatures every night and a zero temperature on one occasion. Some of the adults had already escaped from the material collected at Cottonwood by Gambs in January, but others emerged on January 23. Old galls of the previous year's growth may be found as late as October 25 (as at Clear Lake in 1923), together with the fully-grown galls of the new generation.

From one small gall I cut an adult 1.5 mm. in length. It is a miniature of the normal insect except in having fewer spots in the wings, and in being generally less hairy.

Heldae has usually been considered one of the most distinct species on our Pacific Coast, and this judgment is well applied to the gall produced by this insect. But the insect, as far as I can see, and as Fullaway pointed out in his original description, is practically identical with *C. multipunctata conspicua*. The two occur on the same species of oak, and they alone, among all species of *Cynips,* produce galls on the petioles and young twigs as well as on the leaves of the oak. *Conspicua* is unknown and there is no other *Besbicus* except *heldae* on *Q. lobata* in the Mendocino-Lake County area. The galls of *conspicua* and *heldae* (see figs. 195 and 198) are identical in plan, altho they do differ so much in superficial form. These several considerations lead me to believe that *heldae* and *conspicua* are derived from the same stock, and represent the closest of existent relatives of that stock.

Cynips (Besbicus) maculosa Weld
agamic forms

FEMALE.—Head hardly narrower than the thorax, entirely rich rufous; the fourth antennal segment of only moderate length; thorax large, moderately heavy, about as high as long, uniformly rich rufous;

anterior parallel lines barely indicated; scutellum of moderate width, finely rugose, with a more or less definite foveal depression which may be more or less divided into foveae; dorsal projections of the hypopygial spine very long; both the cubital and discoidal cells with numerous circular brown spots and with faint clouded patches, or the spots very faint in the discoidal cell; length 3.0 to 4.3 mm.

GALL.—Moderate sized, hard, spherical to flask-shaped leaf gall, up to 9.0 mm. in length and 7.0 mm. in greatest diameter. Regular, spherical to bulb-shaped, attached by a moderately stout, blunt tip which may be up to 1.0 mm. in diameter, evenly but rather abruptly enlarged into a swollen, ovoid body which is well rounded at the tip; essentially smooth and naked, but the epidermis thin, becoming papery, broken, and more or less dehiscent when mature and dry, making the gall appear ragged or (after the epidermis has dropped) leaving it very smooth and polished; the young galls greenish, mottled with white, becoming more yellowish, light orange, pinkish, or reddish brown, finally becoming light to dark brown or blackish. The outer wall of the gall of moderate thickness, hard, compact crystalline, somewhat brittle; the

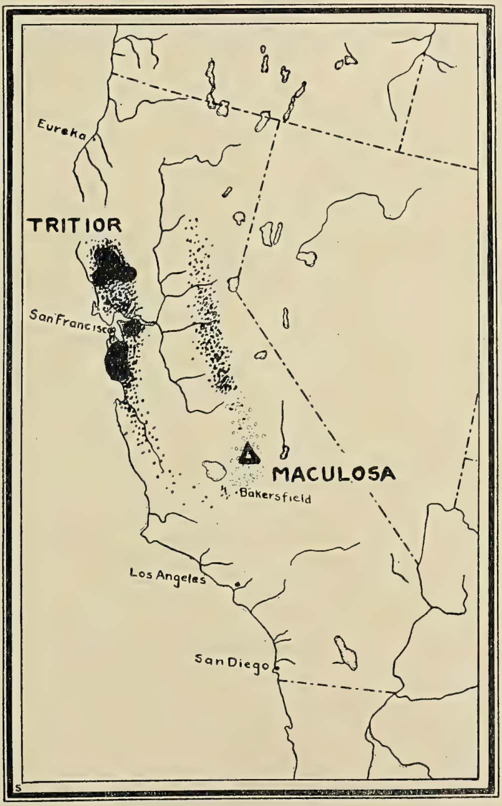


FIG. 33. VARIETIES OF CYNIPS MACULOSA
Geographically isolated.

larval cell central in the swollen portion of the gall, at first small with a distinct cell wall, held in place by rather dense, irregular, tangled, crystalline fibers; the larval cell finally up to 3.0 mm. in length, then filling a large part of the gall, the fibers being then compressed into a more solid mass. Attached usually to the veins, on the under side of the leaf, sometimes on the upper side or on the petiole. On *Quercus dumosa* and *Q. durata.*

RANGE.—Known from Mendocino and Lake Counties southward in the mountains along the coast and in the Sierras as far as the Sequoia National Park. Figure 33.

The interesting gall of this species is apparently not rare in an area including Mendocino and Lake Counties, but there are no records for what is technically Southern California even tho one of the hosts, *Q. dumosa,* is one of the common oaks in that part of the state.

The gall of *maculosa* is not to be confused with that of any other cynipid, but the insect very closely resembles *Cynips mirabilis,* differing chiefly in having a shorter fourth antennal segment, less heavily clouded patches on the wings, usually several spots in the discoidal cell, and a smaller size. It is instructive to compare the descriptions of the two insects and note how dependent we are on the physiologic measure (the gall) for separating them.

Cynips maculosa variety **maculosa** Weld

agamic form

Figures 33, 214, 221

Cynips maculosa Weld, 1926 (in large part), Proc. U.S. Nat. Mus. 68 (10): 63 (*not* figs. 11, 44).

FEMALE.—Color almost uniformly light brownish rufous, only the tips of the antennae and sometimes the abdomen a little darker; thorax rather slender, about twice as long as broad; the foveal groove narrow, shallow, not well marked off from the rest of the scutellum, not separated into foveae; the abdomen more slender, almost twice as long as high; the expanded tip of the second abscissa of the radius of moderate size only; areolet of moderate size; length 3.1 to 4.3 mm., averaging nearly 4.0 mm., generally longer and more slender than *tritior.* Figures 214, 221.

GALL.—Very similar to that of variety *tritior*, more nearly spherical; on leaves of *Quercus dumosa.*

RANGE.—California: Sequoia National Park below Cedar Creek checking station (types, Weld coll.).

Probably restricted to higher elevations in the Sierras. Figure 33.

TYPES.—Holotype and 9 paratype females and 6 galls in the U.S. National Museum, Cat. No. 27205. Paratype females and galls in the American, Field, Philadelphia Academy, and Stanford Museums, and in the Kinsey collection. From the Sequoia National Park, California; galls September 9, 1922; adults cut out November 10, 1922; *Q. dumosa;* Weld collector.

The holotype and all but the Stanford paratypes have been examined in making the present re-descriptions.

We know nothing of this variety beyond the data with Weld's type material. The galls were collected on September 9 (in 1922), at which time some of them were still green while others were turning brown. They then contained full-grown larvae which pupated about October 1. Living adults were cut from the galls on November 10. The insects probably emerge normally in December or January.

Among the galls designated as paratypes of *maculosa,* only those from the Sequoia National Park represent this variety. The others, from other localities, are typical *tritior.*

Cynips maculosa variety **tritior,** new variety

agamic form

Figures 33, 199, 207-208, 222

Cynips maculosa err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 63, figs. 11, 44.

Female.—Color almost uniformly rich, deep rufous, the terminal half of the antenna dark brown, the abdomen rich, dark rufous; thorax quite robust, not more than three-quarters again as long as broad; the foveal groove of moderate width, rather deep, with a more or less definite separation into foveae; the abdomen more robust, about half again as long as high; the expanded tip of the second abscissa of the radius large; areolet very large; length 3.0 to 3.5 mm., averaging a little shorter and stouter than variety *maculosa.* Figure 222.

GALL.—Very similar to that of variety *maculosa* but often elongate, bulboid in shape; on leaves of *Quercus durata* and *Q. dumosa.* Figures 199, 207-208.

RANGE.—California: Ukiah, Lakeport, and Los Gatos (galls, acc. Weld 1926). 6 miles west of Highland Springs; Scott Valley in Lake County (P. Schulthess in Kinsey coll.). Lower Lake; Diablo (F. A. Leach in Kinsey coll.). 7 miles southeast of Kelseyville (galls, D. Hildebrand in Kinsey coll.). Kelseyville (types, Schulthess in Kinsey coll.). Sonoma County (galls, Koebele in U.S. Nat. Mus.). Black Mountain in San Mateo County (H. Morrison in U.S. Nat. Mus.). Santa Cruz Mountains (Koebele in U.S. Nat. Mus.).

Probably extending little beyond an area including Mendocino and Lake Counties and a narrow border about the Central Valley of California. Figure 33.

TYPES.—4 females, 9 galls. Holotype female and galls in the Kinsey collections. Galls at the U.S. National Museum. Labelled Kelseyville, California; galls November 1, 1925, and September 26, 1926; *Q. durata;* P. Schulthess collector.

This is the more widespread variety of the species, occurring on *Q. durata* and *Q. dumosa* in Lake County and other points of the same faunal area. The types are from *Q. durata,* but our five insects from Scott Valley from *Q. dumosa* seem inseparable from the types, and it is not surprising to find that these closely related oaks have not affected an isolation of distinct varieties within this faunal area.

Galls collected by Miss Hildebrand near Kelseyville on July 26 (1927) were young and for the most part small, nearly solid, and without the loosened epidermis of the older galls. A few of the galls of that same collection were, however, of nearly full size. Mr. Leach found full-sized but immature galls on August 3 (in 1924), and his material collected on September 2 (in 1923) was nearly enough mature to allow adults to develop in our breeding bags. The Scott Valley material collected October 2 (in 1926) emerged on December 18 (out-of-doors at Bloomington, Indiana). None of the adults had yet emerged from the galls Miss Schulthess collected on November 1 (in 1925), but the insects from this material were found emerged and dead on the following January 20. The Highland Springs material, collected in the middle of November, emerged on January 21 (1927). The San Mateo County material, collected by Morrison in December, from which he reared an adult "the next summer," was probably abnormal in development, due to some factor in the method of breeding.

Cynips (Besbicus) mirabilis Kinsey

agamic forms

FEMALE.—Head distinctly narrower than the thorax, rufous, sometimes darker in places; the fourth antennal segment quite long; the thorax large, heavy, and broad, fully as high as long, three-quarters again as long as wide; anterior parallel lines rather distinct; scutellum rather broad, not coarsely rugose, with broad, rather deep, indefinite

foveae that are more or less distinctly separated, each fovea broadly oval in shape; dorsal projections of the hypopygial spine very long; the cubital cell usually with, sometimes without such spots; length 3.7 to 5.0 mm., usually nearer 4.5 mm.

GALL.—Large, spherical, spotted, thin-shelled leaf galls with dense, silky, radiating fibers. Up to 33.0 mm., averaging nearer 20.0 mm. in diameter, symmetrical, normally spherical except where drawn out a bit at the attachment; very finely pubescent when young, largely smooth and naked when old, only microscopically shagreened, greenish or with a reddish tinge when young, brownish yellow or more russet when old, more or less closely set with small, reddish-purple spots. Rather thin-shelled, the larval cell central, supported by numerous, fine, silky, radiating, branched fibers, the cell large, broadly oval, up to 5.0 mm. in length. Attached to the larger veins, singly or near each other, on the under surfaces of leaves of *Quercus garryana*. Figure 197.

RANGE.—Probably found wherever *Q. garryana* or any of its forms occur, from British Columbia into northern California and further south along the Sierras. Figure 34.

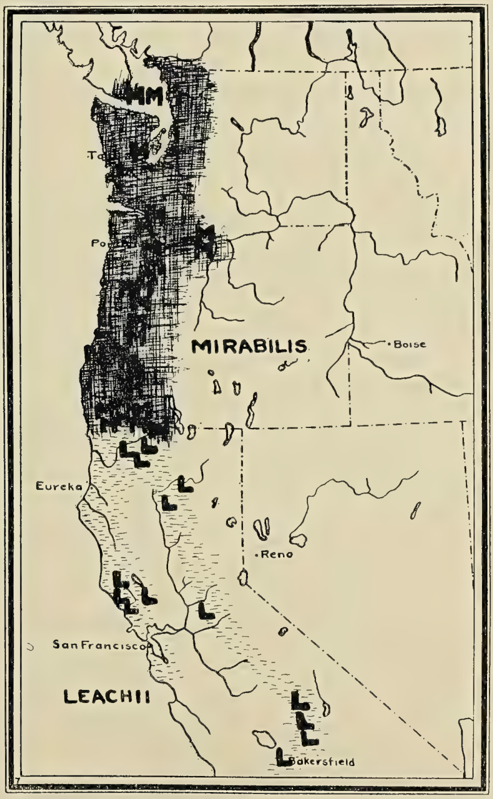


FIG. 34. VARIETIES OF CYNIPS MIRABILIS
Both on *Q. garryana*, but geographically isolated.

The gall of this species is one of the commonest and most attractive of the cynipid productions in the Pacific Northwest. There are at least two distinct varieties of the species, the galls of the two being indistinguishable altho the insects are readily separated. In spite of the many galls in our collections, few adults of this species have ever been bred, and we shall have to study larger series of the insects before we can determine the exact ranges of the varieties. One of the varieties is clearly more northern than the other.

The two varieties are probably similar in their life histories. The young galls appear early in July, becoming full-grown late in August. Weld records pupae in mid-September. Emergence occurs in October over at least the more northern parts of the range. None of the galls that I have examined contained adults after the first of November. Weld's records of living adults in dry galls on November 10, January 13, and February 14, and his emergence record for April 1 may apply to more southern localities if they are not abnormal. The galls remain attached to the leaves as they fall to the ground, and they may be gathered in good condition thruout the next spring and even in the following summer. Small, flattened galls not more than 8.0 mm. in diameter and 5.0 mm. high are usually to be found on the same trees that bear the full-sized specimens, but the single adult I have from such galls appears identical with the normally large insect. I have no explanation for the stunted development of so many of the growths.

There are very few, minor points of difference between the insects of *Cynips mirabilis* and *Cynips maculosa (q.v.)*. The galls of the two species are very distinct, providing another instance of the importance of physiologic data in taxonomy.

Cynips mirabilis variety **leachii,** new variety

agamic form

Figure 34, 215, 216, 223

Cynips maculipennis err. det. McCracken and Egbert, 1922 (Mendocino Co. record only), Stanford Univ. Publ. 3 (1): 19. Essig, 1926, Ins. Western No. Amer.: 807, fig. 675.

Cynips mirabilis Kinsey, 1922 (part of Calif. records), Ind. Univ. Study 53: 50. Weld, 1926 (part of Calif. records), Proc. U.S. Nat. Mus. 68 (10): 64. Essig, 1926, Ins. Western No. Amer. :807.

FEMALE.—Head, thorax, abdomen, and legs entirely rich rufous, only slightly darker in places, nowhere black; the mesonotum with only a trace of the median groove right at the scutellum; anterior parallel lines not widely separated nor divergent posteriorly; foveae very sparingly, very shallowly sculptured, more nearly separated than in variety *mirabilis;* second abscissa of the radius ending in a very large, triangulate tip; areolet very large. Figures 215, 216, 223.

GALL.—As described for the species, indistinguishable from that of variety *mirabilis;* on *Quercus garryana* (and its variety *semota?*). Figure 197.

RANGE.—California: Yreka?, and Ukiah (galls, Kinsey coll.). Fort Jones(?), Scott Bar(?), and Sequoia National Park (acc. Weld 1926). Yorkville, (types, F. A. Leach coll.). Pit River in eastern Shasta County (F. A. Leach in Kinsey coll.). Millville and Hot Springs in Shasta County (galls, F. A. Leach in Kinsey coll.). Elsies Creek in Amador County (gall, G. Hansen in Gray Herb.). Sonoma County (in U.S. Nat. Mus.). In Napa County 12 miles southeast of Middletown (gall, "*Q. dumosa,*" Schulthess and Hildebrand in Kinsey coll.). Bakersfield (galls, H. L. Bauer in Kinsey coll.). Hoff in Tulare County (galls, F. A. Leach in Kinsey coll.).

Probably confined to the more southern range of *Q. garryana* in California. The southern Sierran records, based on galls alone, need re-determination. Figure 34.

TYPES.—3 females, 29 galls. Holotype females, paratype females, and galls in the Kinsey collection. Galls in the American Museum of Natural History, the U.S. National Museum, the Museum of Comparative Zoölogy, Stanford University, and the California Academy. Labelled Yorkville, California; October 29, 1922; *Q. garryana;* F. A. Leach collector.

This is the more southern variety of *mirabilis*. Mr. Leach collected young galls at Hot Springs in Tulare County (perhaps a distinct variety) as early as July 5 (1927), and in Shasta County on July 19 (in 1924). The type galls were collected on October 29 (at Yorkville in 1922) at which time practically all of the adults had emerged. Three mature adults had eaten their way out of the larval cell but were prevented from emerging either by the mass of the fibers or by the drying out of the outer shell of the gall. They were alive in this position in the galls for at least a half month. Five adults from Sonoma County, represented in the National Museum, are labelled January.

A single gall which I have from northern Napa County (12 miles southeast of Middletown) is recorded as from *Q. dumosa*. Whether this is an error for *Q. garryana* (altho

garryana is not yet recorded by the botanists from northern Napa County) I cannot determine at this time; but it is certain that some variety of *mirabilis* is represented in that part of Napa County.

I am naming this *Cynips* for the late Frank A. Leach of Piedmont and Diablo, California, one of the pioneer newspapermen of the state, formerly Director of the San Francisco Mint and formerly Director of the U.S. Mints. For a number of years Mr. Leach, with the aid of his son E. R. Leach and numerous friends, made collections of gall wasp material from a wide range of localities in California. Data from this material are acknowledged in two of my earlier papers, and in connection with many of the Californian insects treated in this paper. It will be some years, as we treat still other groups of Cynipidae, before we can fully appreciate Mr. Leach's contributions, and I am glad to connect his name now with a conspicuous gall of the Pacific Coast.

Cynips mirabilis variety **mirabilis** Kinsey

agamic form

Figures 34, 197, 209, 210, 224

Holcaspis maculipennis err. det. Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 43, pl. 9 figs. 2-3.

Amphibolips quercus-inanis err. det. Trotter, 1910, Boll. Lab. Portici 5: 101.

Cynips maculipennis Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 344. Felt, 1918 (in part), N.Y. Mus. Bull. 200: 100, fig. 63 (2-3). McCracken and Egbert (in part, 1922, Stanford Univ. Publ. 3 (1): 19.

Cynips mirabilis Kinsey, 1922 (except part of Calif. records), Ind. Univ. Study 53: 50. Weld, 1926 (except part of Calif. records), Proc. U.S. Nat. Mus. 68 (10): 64. Houard, 1928, Marcellia 24: 109.

Disholcaspis maculipennis Huber, 1927, Proc. U.S. Nat. Mus. 70 (14): 7, 50, 66, 88, 89.

[NOT *Holcaspis maculipennis* Gillette, 1894, Canad. Ent. 26: 236.]

Female.—Head rich rufous, darker on the median ridge and on the mouthparts; thorax rich rufous, almost black in places especially anteriorly between the parapsidal grooves and about the lateral lines; abdomen dark rufous, rufous to black dorsally; legs bright rufous, darker on the tibiae and tarsi; median groove shallow and indefinite but indicated for nearly half the length of the mesonotum; anterior parallel lines widely separated, divergent posteriorly; foveae distinctly sculptured, separated only by a fine ridge of raised sculpturing; second abscissa of the radius ending in a large, rounded, club-shaped expansion; areolet moderately large. Figure 224.

GALL.—As described for the species, indistinguishable from that of variety *leachii;* on *Quercus garryana.* Figures 197, 209-210.

RANGE.—British Columbia: Victoria (galls, acc. Weld 1926).

Washington: San Juan Island, Tillicum, and Shelton (galls, acc. Weld 1926). White Salmon (galls, Kinsey coll.).

Oregon: Goble (E. J. Perkins in U.S. Nat. Mus.). Portland, (types, E. O. Hovey coll.). Odel, Eugene, Cottage Grove, Oakland, Canyonville, Wolf Creek, Kerby, Holland, McLeod, and Siskiyou (galls acc. Weld 1926). Cottage City (galls, O. J. Murie in U.S. Nat. Mus.). Albany (Silvestri in Kinsey coll.). Salem (Duncan, acc. McCracken and Egbert 1922). Corvallis (galls, H. A. Scullen in Kinsey coll.). Canby, Junction City, Roseburg, Grants Pass, and Ashland (galls, Kinsey coll.). Marshfield (galls, C. L. Hubbs in Kinsey coll.).

California: McConaughy in Siskiyou County (R. W. Patterson in Stanford coll.).

Probably wherever *Q. garryana* occurs, except in the more southern range of the oak in California. Figure 34.

TYPES.—5 females, 10 galls. Holotype and paratype females and galls in the American Museum of Natural History; paratype females and galls in the Kinsey collection. Labelled Portland, Oregon; October, 1905; E. O. Hovey collector.

All of this type material was re-examined in making the present re-descriptions.

PARASITES.—*Callimome perplexum Huber* (acc. Huber 1927).

C. giganticum Huber (acc. Huber 1927). Very doubtful determination of the parasite!

C. californicum (Ashmead) (acc. Huber 1927).

This is the more northern of the two varieties known for the species. When we examine enough adults, we may find that some of the locality records given above do not represent this variety. The Fullaway (1911) description fits variety *mirabilis* better than *leachii,* indicating that *mirabilis* ranges southward at least as far as Siskiyou County, California.

It was thru Beutenmüller's mistaken determination of material of this variety (the same material which I later used as types of *mirabilis*) that the present species was confused with Gillette's *maculipennis.* Professor Trotter has sent me specimens of the Silvestri material which was reported as *Amphibolips quercus-inanis,* and I find it to be typical *mirabilis.*

Cynips subgenus **Philonix** Fitch

bisexual and agamic forms

Philonix Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 783. Cresson, 1862, Proc. Ent. Soc. Phila. 1: 203. Ashmead, 1903 (in part), Psyche 10: 148. Beutenmüller, 1909 (in part only), Bull. Amer. Mus. Nat. Hist. 26: 246. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 12. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 61.

Philonyx Dalla Torre, 1893, Cat. Hymen. 2: 59. Beutenmüller in Smith, 1910 (in part), 598. Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 373.

Cynips subgenus *Teras* of some of the Osten Sacken and Packard assignments.

Philonips of Bassett, 1870, Trans. Ent. Soc. London, 1870: XV.

Biorhiza in some of the Ashmead and Cresson assignments. *Philonix* united with *Biorhiza* in Dalla Torre and Kieffer, 1910, Das Tierreich 24: 402.

Biorrhiza in the Dalla Torre, and Dalla Torre and Kieffer earlier assignments.

Acraspis of numerous authors. *Acraspis* united with *Philonix* in Ashmead, 1903, Psyche 10: 148; also in Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 246.

Dryophanta, as authors have assigned the bisexual forms.

Diplolepis as other authors have assigned the bisexual forms.

Cynips of one assignment of Weld (for the species *plumbea*).

FEMALE.—The cheeks moderately enlarged behind the eyes; the antennae moderately long, with 13-14 (or indistinctly 15) segments; the thorax of normal size or much reduced and hardly longer than high; the parapsidal grooves distinctly continuous; the median groove lacking; the mesopleuron more or less completely punctate; abdomen varying from largely smooth and naked to an abdomen with all of the segments hairy laterally; the hypopygial spine of long-winged forms moderately broad and projecting ventrally, short-winged forms with the spine very broad with an abruptly truncated tip; the tarsal claws rather large and heavy, strongly toothed; normal wings 1.17 times the body length, those of the short-winged forms only 0.4 to 0.65 times the body length and with a reduced venation or mere traces of a venation; the normal wings with the second abscissa of the radius only slightly curved, straighter in the bisexual forms; the radial cell of moderate length, not narrow; the third cubital cell with mere traces of a blotch basally and of spots nearer the tip of the cell; fair-sized insects, the agamic forms 2.7 to 4.9 mm., the bisexual forms 2.3 to 2.8 mm. in length.

MALE.—Differing from the bisexual female as described for the genus.

GALLS OF AGAMIC FORMS.—Spherical, thin-shelled, naked or finely pubescent, with the central larval cell supported by dense, radiating fibers or closely embedded in more compact tissue; occurring singly, on the leaves of white oaks.

GALLS OF BISEXUAL FORMS.—Egg-shaped cells with one end flattened; buried in unmodified buds, or surrounded by a few slender, thread-like remnants of leaves.

RANGE.—Known from the northeastern United States to Florida and Arizona. To be expected from Mexico. Figure 35.

FIG. 35. KNOWN RANGE, SUBGENUS PHILONIX
One species known from each area.

SUBGENOTYPE.—*Philonix fulvicollis* Fitch. One of the two species originally included by Fitch. Designated as genotype by Ashmead, 1903, Psyche 10: 148.

Cynips pezomachoides Osten Sacken designated as genotype by Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 246, is unacceptable because of previous designation and because *pezomachoides* was not included in the original description of *Philonix.*

This subgenus has previously been recognized from four agamic forms which I consider varieties of the species *fulvicollis.* Additional varieties of *fulvicollis* have now been recognized so that species now includes seven agamic forms (with three additional names which are synonyms), all of which occur in the United States east of the Rockies.

It was, of course, to have been expected that an alternating, bisexual generation of long-winged insects would be discovered, and it should have awakened some interest to know that the bisexual form of as common an eastern American species as *fulvicollis* was not yet recognized. We are now taking *Cynips pallipes* (Bassett) to be this bisexual form of the variety *fulvicollis*, and the subgeneric characteristics of *pallipes* have allowed us to recognize the Southwestern *plumbea* as the second species of the subgenus. The data for these conclusions are given under *pallipes* and *plumbea* respectively.

The wing-body ratio of the normal insect of *Philonix* is 1.17, the shortest normal wing in the genus *Cynips* and a wing that is noticeable to the naked eye as shorter than the normal wing of *Acraspis*. The hypopygial spine of the long-winged form is broader than in any of the other subgenera except *Antron* and *Besbicus*. In the short-winged agamic forms, the spine is as much warped from the normal as it is in the subgenus *Acraspis*.

Since the connection of the long-winged *plumbea* with the eastern *fulvicollis*, there remains small reason for debating the relation of *fulvicollis* to the rest of the genus *Cynips*. Even the short-winged forms of *fulvicollis* show the head characters, the size, pubescence, thoracic sculpture, the foveal groove, the leg characters including the tarsal claws, and the distinctive hypopygial spine of true *Cynips*. Direct comparison with *folii*, the genotype, should be convincing proof of this relationship if one makes allowance for the reduced size of the wings and of the thorax and the increased size of the abdomen.

The galls of both *fulvicollis* and *plumbea* are those of typical *Cynips*. The agamic galls resemble those of *Cynips mellea* of the eastern United States and *Cynips multipunctata* of the Pacific coast. The dates of appearance and maturity of the galls of *fulvicollis* and *plumbea*, and the early maturity but late, mid-winter emergence of the agamic insects are so typical of *Cynips* that they are among the strongest reasons for including these species in the genus.

Cynips (Philonix) plumbea Weld

agamic form

Figures 36, 200, 225-226, 235-236, 246

Cynips plumbea Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 64, fig. 12.

FEMALE.—Almost the entire body light brownish rufous, darker to brown only on the very tips of the antennae and on the tarsal claws, the anterior parallel and lateral lines and the abdomen ventrally brownish rufous, darker than the rest of the body; the thorax, abdomen, and wings of normal size; the parapsidal grooves narrow but distinct and continuous; the anterior parallel and lateral lines merely indicated as smoother, more naked areas; the scutellum rugose, distinctly elongate, anteriorly depressed to form the broad, roughly rugose and entirely undivided foveal groove; the scutellum anteriorly emarginate; the abdomen not greatly produced dorsally, with the sides of all the abdominal segments punctate and moderately hairy, the surfaces of the posterior segments more closely punctate to finely rugose; the wings normal, 1.17 times the body in length, the veins yellowish brown, the first abscissa of the radius of moderate weight and angulate with a slightly projecting tip, the second abscissa of the radius slender, somewhat curved toward the tip, the tip abruptly triangulate or bent; the areolet of moderate size, variable; all of the cells without spots or blotches except for traces of a blotch at the base of the third cubital cell and another nearer the tip of the same cell (these spots not evident in all specimens); length of the insect 2.7 to 4.6 mm. Figures 235, 236, 246.

GALL.—Spherical, thin-walled, brownish, naked, the centrally-placed larval cell imbedded in spongy or more compact tissue. Monothalamous; up to 11.0 mm., averaging nearer 8.0 mm. in diameter. Strictly spherical except for the broadly flattened base; not at all shrivelled when old; the gall greenish or rose-tinged when young, becoming lead color with a bluish gray bloom that is easily wiped off and largely wears off the older galls, exposing the brownish tan color of the older galls; the surface all but microscopically smooth and naked except for the deciduous bloom. The outer wall of the gall moderately thin but firm because it is inseparable from the rest of the gall; the gall internally more or less compact-crystalline, in some cases indicating a more fibrous structure, the larval cell central, closely embedded and entirely inseparable from the compact material of the gall. Attached by a fine point, singly on the main veins, usually underneath the leaves, on *Quercus oblongifolia* and *Q. arizonica* (and related southwestern oaks?). Figures 200, 225-226.

RANGE.—Arizona: Globe (var.? galls, *Q. arizonica,* Kinsey coll.). Whetstone (galls, *Q. arizonica,* Kinsey coll.). Oracle (*Q. arizonica,* Weld and Kinsey coll.). Santa Catalina Mountains (M. Chrisman acc. Weld 1926). Esperara Canyon in Santa Catalina Mountains (types; *Q. oblongifolia;* Hofer and Edmonston coll.). Sabino Trail in Santa Catalina Mountains (*Q. oblongifolia, Q. arizonica;* Kinsey coll.). Santa

Rita Mountains (*Q. oblongifolia,* Weld and Kinsey coll.). Fort Huachuca (*Q. arizonica,* Kinsey coll.; gall, acc. Weld 1926). Courtland (*Q. arizonica,* Kinsey coll.). Chiricahua Mountains (*Q. arizonica,* acc. Weld 1926). Nogales, Patagonia Mountains, and Tumacacori Mountains (galls, acc. Weld 1926).

This variety probably restricted to more southern Arizona and southwestern New Mexico, altho related varieties may be expected elsewhere in the Southwest and in Mexico. Figure 36.

TYPES.—The holotype, 45 paratype insects, and galls from Esperara Canyon (East) in the Santa Catalina Mountains, Arizona; galls November 27, 1917; insects December 14, 1917, and January 8 and 25, 1918; *Q. oblongifolia;* Hofer and Edmonston collectors (Hopkins U.S. No. 13687b). One paratype insect and gall also from Santa Catalina Mountains, Arizona; insect November 22, 1915; M. Chrisman collector

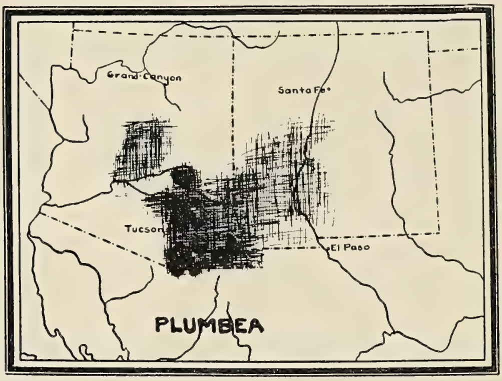


FIG. 36. CYNIPS PLUMBEA
Possible extension of known range shown by shading.

(Hopkins U.S. No. 13643*s*). 6 paratype insects and galls from Santa Rita Mountains; galls December 7, 1921; insects January 12 and 13, 1922, and February 3 and 4, 1922; *Q. oblongifolia;* L. H. Weld collector. 48 paratype insects and galls from Oracle, Arizona; galls December 17, 1921; insects December 30, 1921, January 24, 1922, and February 6, 1922; (Hopkins U.S. No. 15639*b*). One paratype insect and a gall from the Chiricahua Mountains, Arizona; adult cut out November 24; *Q. arizonica;* L. H. Weld collector.

Holotype and many paratype insects and galls in the U.S. National Museum. Paratype insects and galls in the American Museum of Natural History, the Field Museum, Stanford University, the Museum of Comparative Zoölogy, Philadelphia Academy, and Kinsey collections. If this large series of paratypes of diverse origin is ever shown to represent more than one variety, recourse must be had to the holotype series cited above.

The present re-descriptions are based on the holotype, a number of the paratypes, and my own material from Arizona.

The gall of this species is not uncommon in the mountains of southern Arizona, altho we have nowhere seen it as abundant as *fulvicollis* is in the East. The species occurs on both *Q. oblongifolia* and *Q. arizonica* thruout the forested elevations below six or seven thousand feet, and the insects agree with many other Cynipidae in showing no appreciable variation on these two oaks. The galls of *plumbea* seem more firmly attached to the leaves than the galls of the easily deciduous *fulvicollis*. *Plumbea* galls probably begin development at some time in June. Weld found pupae in some galls on December 7 (1921), but a mature adult in another gall as early as November 24. This adult, when cut from the gall, lived in a pill box until January 1, just as it would have lived for some time as an adult before emerging from the gall. In this delayed emergence *plumbea* is in accord with the other species of *Cynips*. As dates of emergence of the adult, Weld records November 22, December 14 and 30, January 8, 12, 13, 24, and 25, and February 3, 4, and 6. I bred insects on January 6, on other dates in the first half of January, and at some date (unrecorded) after January 16 (gall in 1920).

By analogy with *Cynips fulvicollis* of the present subgenus, the bisexual form of *plumbea* may be expected in a small, seed-like gall occurring in the buds of the oaks early in the spring.

The hairy abdomen of this insect led Weld to describe it as a *Cynips*, by which he meant the European genus *Adleria* instead of the group treated in our present monograph. Nevertheless, all of the diagnostic characters of the true genus *Cynips*, of which *Cynips folii* is the type, are to be noted in the morphologic structures of this insect, and the broadened hypopygial spine, characteristic gall, and delayed emergence of the adult are outstandingly *Cynips* characters. More detailed proofs of the subgeneric relations follow.

Plumbea has a hypopygial spine which rules it out of all the subgenera of *Cynips* except *Antron* and *Philonix*, as references to the figures in this study will verify. The wing venation and clear wing cells of *plumbea* (see figure 236) and its wing-body ratio of 1.17 clearly rule it out of *Antron*, as does its gall and geographic distribution. We apparently know no other long-winged *Cynips* subgenerically related to *plumbea* except the eastern American bisexual form *pallipes* which will be discussed in a moment.

Plumbea, however, has certain characters in common with the short-winged insect *fulvicollis* of the subgenus *Philonix.* The description of *Philonix,* originally written exclusively for *fulvicollis,* has needed no modification at any point except in regard to the abdominal pubescence, wing, and hypopygial spine characters. The inclusion of naked and hairy abdomens in a single subgenus or even a single species, however, is not without precedence in *Cynips,* as witness *hirta, gemmula,* and *pezomachoides* in *Acraspis,* and the varieties of *nubila* and *villosa* in the same subgenus. The relations of long- and short-winged species are definitely shown for *Antron, Atrusca,* and *Acraspis* in the present study and the wing mutations will account for the differences that we find between the head, thoracic, and abdominal proportions of *fulvicollis* and *plumbea.* The character of the hypopygial spine of *Acraspis,* where the long-winged varieties have more elongate spines than the short-winged varieties, would warrant our allowance for the differences between the spines of *fulvicollis* and *plumbea.* Finally, the gall of *plumbea* is so strikingly similar to that of *fulvicollis* that I now wonder why I was not impressed by the resemblance long ago. I have considerable confidence in the value of the gall pattern as an indicator of the phylogenetic relations of gall wasps.

As another source of evidence, the bisexual *Cynips pallipes* (Bassett) proves to have important characters in common with *plumbea.* The hypopygial spines of the two are similar, with allowance necessary thruout the genus *Cynips* of a more slender spine in a bisexual form. More striking is the identity of the wing-body ratios of the two, for a ratio of 1.17 is found nowhere else among normal wings in the genus *Cynips.* The other subgenera of *Cynips* have ratios of 1.30, 1.35, 1.50, 1.50, and 1.60 respectively. If we are correct in our conclusion that *Cynips pallipes* (*q.v.* for further discussion) is a bisexual form of *Cynips (Philonix) fulvicollis,* then we may conclude that *plumbea* is also a *Philonix.*

Cynips (Philonix) fulvicollis (Fitch)

bisexual and agamic forms

AGAMIC FEMALE.—Generally dark rufous to piceous and black, two varieties brighter rufous, the abdomen usually darker than the head

and thorax; thorax much reduced in size, hardly longer than high, three-quarters again as long as wide; parapsidal grooves only gradually convergent at the scutellum and gradually divergent anteriorly, rather narrow, more or less indistinct and shallow, especially anteriorly; scutellum small, a little longer than wide, with a rounded tip, coriaceous to finely rugose, anteriorly much depressed, this forming a foveal groove without a trace of a division into foveae, the narrow foveal ridge arcuate; abdomen much enlarged, somewhat compressed, up to half again as long as high, not produced dorsally, the second segment covering hardly half of the abdomen, hardly at all produced dorsally; wings very short, extending at the most to the middle of the abdomen, with more or less indefinite traces of a venation, the subcosta and the basalis the most persistent veins; the hypopygial spine very broad and abruptly truncate terminally; the length of the insect 2.0 to 4.9 mm.

BISEXUAL FEMALE AND MALE.—Known for only a single variety, so see the description for variety *fulvicollis* form *pallipes*.

GALL OF AGAMIC FORM.—Spherical, thin-shelled, gray, usually pubescent, the central larval cell supported by a dense mass of radiating fibers. Monothalamous; up to 20.0 mm., in most varieties averaging nearer 8.0 mm. in diameter. Strictly spherical when fresh, but becoming a bit shrivelled and misshapen when dry; white, rose-tinged when fresh, becoming flesh-colored, ashen, or brown when mature; the surface shagreened, crystalline, slightly uneven, the raised spots bearing stellate hairs, the entire surface more or less pubescent, sometimes dense with a considerable pubescence when young, becoming more naked when mature. The outer wall moderately thin, papery or harder, not translucent; the young galls more or less solid, succulent, the older galls dry, well packed with fine, dense, radiating fibers which support the more or less spherical larval cell centrally. Attached by a fine point, singly, on the main veins, usually underneath the leaves, on all the more eastern American white oaks except those of the *Q. virginiana* group.

GALL OF BISEXUAL FORM.—An egg-shaped cell with one end flattened; buried in unmodified buds, or surrounded by a few, slender, thread-like remnants of leaves. See the description under variety *fulvicollis* form *pallipes*.

RANGE.—Thruout the eastern United States, known from Maine, Ontario, and Michigan west to Nebraska and south to Florida and Oklahoma. Figures 37-42.

The galls of the agamic forms of *fulvicollis* are common on most of the species of white oak that occur over the northeastern two-thirds of the United States, often covering the ground under certain trees as closely as pebbles on a gravel drive. The more southern varieties of the species seem much more rare, being poorly represented in our collections altho I

have done extensive field work in that portion of the country. Young galls of *fulvicollis* appear in June or July, earlier further south (June 6, 1927, in southeastern Kansas). Fully grown galls occur among the June collections from Kansas and in an August 25 collection from Roselle, New Jersey. The galls are deciduous, falling to the ground in September or October, by which time they contain some pupae. Adults are to be found in the galls in October of the year in which emergence occurs, but the insects do not chew out before the middle of November. Most of the emergence occurs before the end of December, but thruout the rest of the winter and early spring the insects continue to come out of the galls on bright days, especially if these have been immediately preceded by very low temperatures. The subapterous adults have been taken on several occasions running over the snow.

The most southwestern variety, *vorisi*, completes most of its emergence in the first winter after the development of the gall, thus holding to the life-history typical for the rest of the genus *Cynips*. On the other hand, some of the individuals of *vorisi*, and most of the insects of *canadensis*, *fulvicollis*, *major*, and *gigas* remain until a second or even a third winter in the galls before transforming into adults. Weld and Brodie first noted this, and my own experience confirms it. While only the northeastern varieties of *fulvicollis* were known, this two-year emergence seemed so exceptional as to suggest the exclusion of the species from the genus *Cynips*. The discovery of the shorter life cycle in our variety *vorisi* indicates how a physiologic quality that is ordinarily of generic rank may be modified by environmental factors. The small amount of first-year emergence which our records show for the more northern varieties may come from second-year galls that were indiscriminately included with first-year specimens in our collections.

On circumstantial evidence, we are now considering the long-winged *pallipes* the bisexual form of one of the short-winged agamic forms of *fulvicollis*. The data for this conclusion are detailed under *pallipes*. This bisexual insect is close to the bisexual forms known in the subgenus *Acraspis*, occurring in a seed-like bud gall very much resembling a bisexual *Acraspis* gall. The most distinctive thing in the bisexual *Philonix* is its unusual wing-body ratio of 1.17

which, however, is the length of the wing of the Southwestern *Cynips (Philonix) plumbea.*

All of the previously recognized members of this species have been short-winged agamic forms. Few groups have had more varied taxonomic treatment, due to the difficulty of interpreting the relations of such specialized insects, and to an unusual amount of individual variation in the species. The genus *Philonix* was originally established by Fitch for his species *fulvicollis* and *nigricollis,* and Ashmead later designated *fulvicollis* as the type. Beutenmüller (1909) and Dalla Torre and Kieffer (1910) revised the generic assignments of these insects, but differed radically in their interpretations—chiefly because they worked with little material and studied few types. They nevertheless agreed in keeping these forms in genera which included none but nearly wingless forms. Weld maintained this policy when he revised the genera *Acraspis* and *Philonix* in 1922, but rendered a service by pointing out the two distinct lines of relationships represented by these two names. Those who have followed my use of the categories of species and variety will readily appreciate that what have hitherto been considered species of *Philonix* should now be considered varieties of one species.

Beutenmüller introduced confusion into our understanding of this group by trying to interpret it from published descriptions without an examination of types. His later study of the types led to an unfortunate synonomy that was, nevertheless, uncritically accepted by several of us for a number of years. He considered his *erinacei* a synonym of *fulvicollis.* I agree with Weld that the two represent distinct genera or subgenera. Beutenmüller was correct in considering (1909) *gillettei* a synonym of *niger,* but incorrect (1918) in considering this the same as *lanaeglobuli.* I believe that *niger, gilletti,* and Fitch's *nigricollis* are synonyms of *fulvicollis.* My reasons for these interpretations, which are in every case based upon my studies of the type material supplemented by series representing a wide range of localities, are detailed in the following pages.

As I understand this species, we have the familiar story of the host or geographic isolation of each variety of the insect. The white oak inhabitants include variety *canadensis* which occurs chiefly in the sub-Canadian area of the northeastern

part of the country, the highly variable *fulvicollis* (of which *nigricollis, niger,* and *gillettei* are synonyms) ranging from Massachusetts to Iowa, south to the Ohio River and still further in the mountains, variety *major* of the Ozark area extending from Indiana to Missouri and Arkansas, and variety *rubricosa* of the Gulf area from Texas eastward and northward to Tennesssee. *Quercus macrocarpa* and the closely related *Q. bicolor* harbor *vorisi* in the Ozark area from Kansas to Illinois and apparently without material variation all the way into northern Indiana. *Quercus lyrata* and the

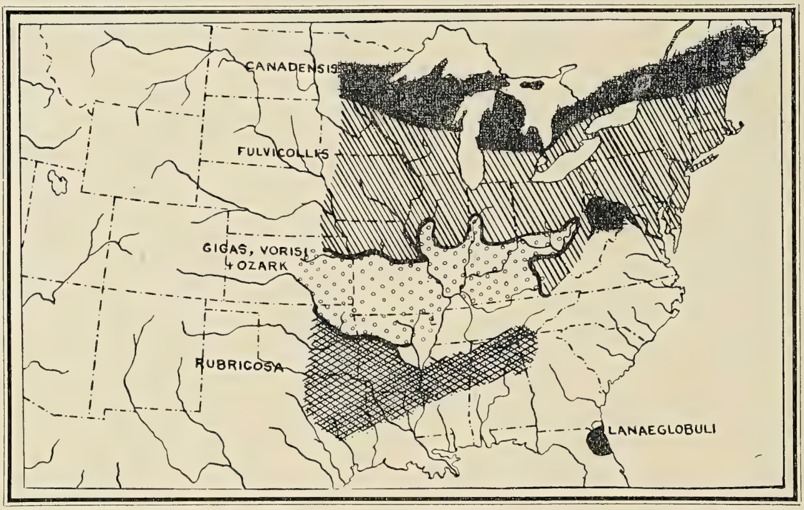


FIG. 37. SUMMARY MAP, VARIETIES OF CYNIPS FULVICOLLIS
Each insect geographically isolated or on distinct hosts. Areas of transition and hybridization not shown. See detailed maps of each variety.

chestnut oaks bear variety *gigas* in the Ozark area. *Quercus bicolor* in Florida has variety *lanaeglobuli.* Whether there is a distinct Coastal Plain variety has not been determinable from the material I have seen. There is some irregular extension of the hosts of these varieties in areas in which the normal hosts are rare or lacking. Beutenmüller (1909, Bull. Amer. Mus. Nat. Hist. 26: 252) notes a *Q. prinoides* gall from New Jersey, and I have material (C. J. Long, Jr., coll.) from the same host and the same state; and this may (or may not) represent another variety.

The geographic isolation of varieties in *fulvicollis* is, unfortunately for our determinations, not as sharp as with other

species of *Cynips*. Indeed, I have never worked with any species of the Cynipidae in which there is more even gradation from one extreme *(canadensis)* to the other *(vorisi)*. Such intergradation does occur commonly among some other organisms, both plant and animal, and it is rather remarkable that it does not occur more often among the Cynipidae. There will, no doubt, be some who would object that such an even series as *fulvicollis* should not be broken up into varieties; but the extremes of the present series are as different in feature and build and physiologic reactions as a Spaniard is from a Swede. There is more than a political purpose served in applying distinct names to those two races or varieties of Europeans, even tho intermediate areas of Europe may exhibit gradations from one to the other. Similarly, it would confuse the biologic data to apply one name to this whole complex of *fulvicollis*. The variety *canadensis*, for instance, is a distinctly small insect with a largely naked mesonotum, a very small gall, a two-year life cycle, and a restriction to white oak in sub-Canadian areas. The variety *vorisi* is a large and robust insect, always with a very hairy mesonotum, a gall which averages twice the diameter (which means eight times the volume) of *nigricollis* galls, a one-year life cycle, and a restriction to *Q. macrocarpa* and *Q. bicolor* in Ozark areas. In the territory between northern Michigan and Kansas, one may find every gradation and a continuous variation from one to the other. Wherever the two insects happen to come in contact, they certainly interbreed and produce individuals not fit for the cabinet of any systematist who believes that all specimens represent one species or another. Among the more than five thousand insects which we have of this group, it has proved possible to make varietal determinations for every series, altho the paucity of available taxonomic characters in these aborted, short-winged, forms and the amount of hybridization makes it impossible to guarantee our determinations of each individual as we can for most other *Cynips*.

The galls of *fulvicollis* sometimes contain a high percentage of parasites and inquilines. Most of the parasites emerge in the first spring after the development of the gall, the emergence occurring from February to July. The inquilines emerge for the most part in the later part of that same spring,

even until late in June. The inquilines appear to act as parasites that have attacked the gall at an early stage of development, for no remains of the gall maker are to be found in inquiline-inhabited specimens.

Cosens (1912: 343) gives a description of the histologic structure of a gall of this species. His account is as follows:

> Outside the nutritive zone is a wide crystal layer, each cell of which is completely filled with a crystal mass. The sclerenchyma of the protective zone is formed in a very unusual manner. The sides of contiguous cells are thickened in such a way that there is an almost spherical deposit at the points where the cells are in contact.
>
> Radiating out from the protective layer are long narrow cells which form the minor part of the parenchyma zone. The remainder of this zone consists of irregularly elliptical, thin-walled cells. The epidermis is covered with a dense growth of trichomes with thick laminated and sclerified walls.

Cosens failed to note a thin collenchyma layer which is to be found directly beneath the epidermis.

Cynips fulvicollis variety **rubricosa**, new variety
agamic form

Figures 38, 237, 247

Philonix nigra err. det. Weld, 1926, Proc. U.S. Nat. Mus. 68(10): 61 (Okla. record only).

FEMALE.—Head rich rufous, face darker (if at all) only medianly; antennae black terminally, the whole basal half brownish rufous, brightest rufous on the first two segments; thorax largely bright rufous both dorsally and laterally, darker in only a few places; the mesonotum moderately punctate and hairy, centrally smoother, naked, and shining; abdomen in part piceous black, with a rather large rufous or rufo-piceous area basally and sometimes ventrally; the hairy patch on the second segment of limited extent; legs almost wholly rufous or bright rufous; wings averaging about 0.38 of the body in length, with subcostal, basal, and reduced discoidal veins and only traces of the other veins; rather small insects 2.5 to 3.3 mm. in length. Figures 237, 247.

GALL.—As described for the species; quite pubescent; up to 9.0 mm. in diameter; on leaves of *Quercus alba* and *Q. stellata.*

RANGE.—Oklahoma: Tuskahoma (galls, acc. Weld 1926).
Texas: Marshall (*Q. stellata,* W. A. Lansford in Kinsey coll.).
Alabama: Athens (gall, Kinsey coll.).
Tennessee: Charleston (types, Kinsey coll.).
Possibly extending thruout a widespread area in the southeastern United States, from eastern Texas to northern Oklahoma, Tennessee, and western Florida. Figure 38.

TYPES.—14 females and numerous galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History and the U.S. National Museum. From Charleston, Tennessee; galls November 9, 1927; insects December 19, 1928, and January 4, 1929. The type series shows some effect of hybridization with a darker insect; the holotype is a bright rufous individual agreeing with the east Texas material.

This variety and Ashmead's *lanaeglobuli* are the most southern forms described for this species. *Cynips fulvicollis* seems not at all common in the more southeastern portion of the United States; and we have little material of the present variety altho we have engaged in field work over many thousands of miles in what would appear to be the range of this insect. The host of three of our collections is *Q. alba,* but a Texas insect from *Q. stellata* seems identical with the holotype of *rubricosa.*

The insects of *rubricosa* are closest to variety *gigas,* but *rubricosa* is much smaller with a much shorter wing and a bright rufous to rufo-piceous patch at the base of the abdomen.

Our Texas material of *rubricosa* emerged on January 7, during the first winter after collecting the galls. All of the insects of the type series, from Tennessee, delayed emergence until the second winter, coming out on December 19 and January 4.

Cynips fulvicollis variety **vorisi,** new variety

agamic form

Figures 38, 230, 238, 248

FEMALE.—Head dark rufous and black, the antennae largely black; the entire thorax dark rufous and black; the entire mesonotum closely punctate and very hairy; the abdomen entirely piceous black, the hairs largely confined to a limited patch on the second segment, with stray hairs sometimes on other segments; legs largely rufo-brown to rufo-piceous; wings relatively short altho appearing larger because of the large size of the insect, only about 0.43 of the body in length, extending to the margin of or beyond the second segment, not narrow, the venation fairly complete basally but incomplete beyond the areolet; a large and distinctly robust insect 3.4 to 4.7 mm. in length. Figures 238, 248.

GALL.—As described for the species, very large, pubescent, up to 17.0 mm. in diameter; on the leaves of *Quercus macrocarpa* and *Q. bicolor.* (Rarely on *Q. Michauxii?*). Figure 230.

RANGE.—Kansas: Winfield (*Q. macrocarpa*, types; R. Voris in Kinsey coll.). 10 miles southeast of Winfield and Cedarvale (*Q. macrocarpa*, R. Voris in Kinsey coll.). Dexter (*Q. Michauxii*, R. Voris in Kinsey coll.).

Illinois: Olney and West Union (*Q. bicolor*, Kinsey coll.).

Indiana: Steubenville (*Q. bicolor*, Kinsey coll.; determination open to question).

Largely restricted to the Ozark area from Arkansas to Indiana, but occurring westward into Kansas and northward to northern Indiana; chiefly confined to *Q. macrocarpa* and *Q. bicolor*. Figure 38.

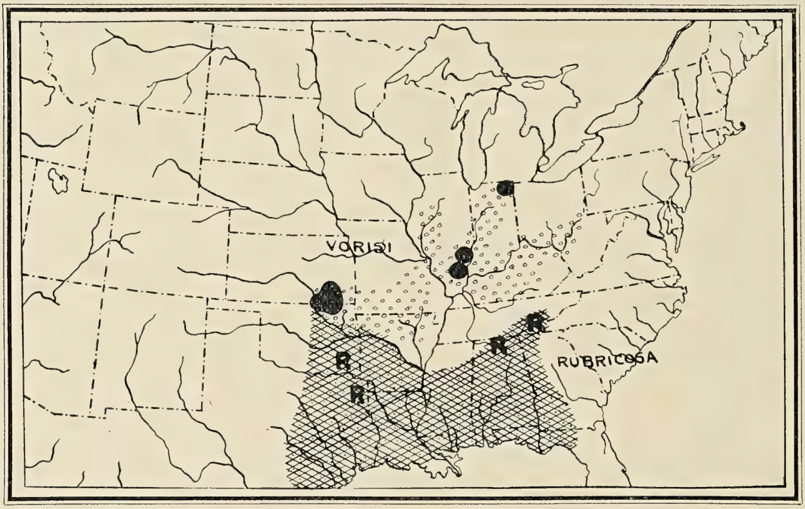


FIG. 38. TWO VARIETIES OF CYNIPS FULVICOLLIS
Possible extensions of known ranges shown by shading.

TYPES.—Several hundred insects and galls. Holotype and paratype females and galls in the Kinsey collection; paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, the U.S. National Museum, the Field Museum, the California Academy, Stanford University, the British Museum, and the Vienna Museum. Labelled Winfield, Kansas; gall August 30, 1927; females December 4, 8, 18, 20, and 28, 1927; January 2, 8, 10, and 25, 1927; February 6 and 20, 1928; and March 10, 1928; *Q. macrocarpa;* R. Voris collector.

This is the Ozark variety of *fulvicollis* on the burr oak, *Q. macrocarpa*, and its close relative, the swamp white oak, *Q. bicolor;* but the species extends well outside the Ozark area both to the west in Kansas and to the northeast into Indiana. Even the *Q. bicolor* material which I have from northern Indiana seems no different from dark specimens of *vorisi,* tho

the northern specimens do thus average differently in respect to color. *Vorisi* is very close to *gigas,* but has less bright rufous on its face and mesonotum. From *major, vorisi* differs in being a larger and much more robust insect. Altho *vorisi, gigas,* and *major* occur in much the same territory, they are on distinct oaks (*gigas* on *Q. lyrata* and the chestnut oaks, *major on Q. alba),* but the host isolation appears to break down in some cases, for perhaps ten per cent of our material of these insects is distinctly intermediate between the several varieties.

Very young galls of *vorisi* were found in southeastern Kansas as early as June 8 (1927). Full-sized galls were obtained by June 15, and galls large enough to breed were found on July 4. This represents earlier development than we know for the northeastern varieties of the species. Most of the adult insects emerge during the first winter, but about ten per cent of our material has emerged in the second winter after collecting. The emergence during the first winter is practically continuous from early December to the end of February, the bulk of it occurring well before the end of December; the emergence in the second winter was confined to December. The recorded emergence dates are December 2, 8, 9, 10, 12, 15, 17, 18, 19, 20, 22, 23, 26, and 28; January 2, 4, 5, 10, and 25; and February 2, 6, and 20.

Almost all of our Kansas material of this insect was collected by Dr. Ralph Voris, of the Southwestern Missouri State Teachers College. For several years Dr. Voris has been a companion in my field work, and many thousands of specimens of Cynipidae and many hours of help on field routine are to be credited to him. He has an appreciation of the importance of individual variation, and to this fact we are indebted for the unusually large series which we have of several of the Cynipidae from Kansas and western Missouri.

Cynips fulvicollis variety **major,** new variety

agamic form

Figures 39, 227, 239, 249

Philonix nigra err. det. Weld, 1926 (so. Mo. record only), Proc. U.S. Nat. Mus. 68 (10): 61.

Cynips fulvicollis var. B Kinsey, 1927, Field and Lab. Manual in Biol.: 108.

FEMALE.—Head dark rufous and black, the antennae nearly black with the first two segments sometimes more rufous; the thorax rich to dark rufous and black; the entire mesonotum moderately punctate and hairy, rarely more shining posteriorly; the abdomen entirely black, with the hairy patches largely confined to the second segment and of limited size; legs brownish to dark brown and piceous; wings about 0.55 of the body length, extending two-thirds of the way along the second abdominal segment, rather narrow, with reduced subcostal, basal, and discoidal veins and but traces of the other veins; a moderately large insect, more robust than *fulvicollis*, less robust than *vorisi;* 3.0 to 4.0 mm. in length. Figures 239, 249.

GALL.—As described for the species, rather large, pubescent, up to 10.0 mm. in diameter; on the leaves of *Quercus alba;* rarely on *Q. Mühlenbergii, Q. Michauxii,* and *Q. macrocarpa.* Figure 227.

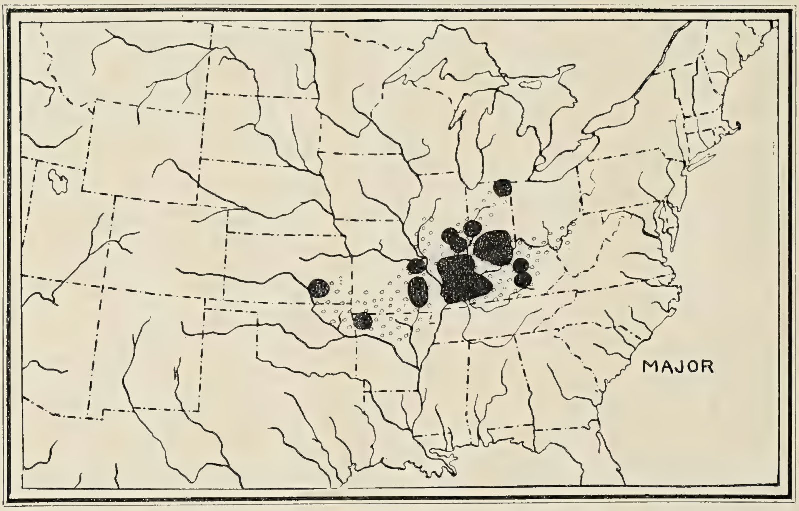


FIG. 39. OZARK VARIETY, CYNIPS FULVICOLLIS ON Q. ALBA
Possible extension of known range shown by shading.

RANGE.—Indiana: Steubenville, Nashville, Bloomington, Clinton, and Linton (*Q. alba,* Kinsey coll.). Spencer (*Q. alba* and *Q. Michauxii,* Kinsey coll.). Letts (*Q. Michauxii,* E. B. Ruth in Kinsey coll.). Charlestown (H. Spieth in Kinsey coll.).

Illinois: Urbana (A. E. Miller in Kinsey coll.). America (types, Kinsey coll.). Bonnie, Bloomfield in Johnson County, West Union, and Norris City (Kinsey coll.). Eddyville (O. Buchanan in Kinsey coll.).

Kentucky: Pinehill, Dawson Springs, Wickliffe, and Paducah (Kinsey coll.). Cleveland (hybrid, *Q. Michauxii,* Kinsey coll.).

Missouri: Rankin (*Q. Mühlenbergii* and *Q. alba,* Kinsey coll.). Arcadia and Poplar Bluff (*Q. alba,* Kinsey coll.).

Arkansas: Winslow (R. W. Shreve in Kinsey coll.).

Kansas: Winfield (*Q. macrocarpa*, R. Voris in Kinsey coll.).

Apparently centering in the Ozarks, extending somewhat beyond this area, from southern Indiana to southern Missouri and (scatteringly) in Kansas. Figure 39.

TYPES.—58 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype insects and galls in the U.S. National Museum, the American Museum of Natural History, and the California Academy. From America, Illinois; galls October 16, 1927; insects December 13, 19, and 23, 1928, and January 3, 1929; *Q. alba;* Kinsey collector.

As one travels southward and westward from Indiana and Illinois, he finds variety *fulvicollis* gradually giving way to a larger and somewhat darker insect which has a more hairy mesonotum. In southern Indiana as far north as Bloomington, and in Illinois as far north as Urbana, one may find many insects which are distinctly intermediate between *fulvicollis* and *major* and not always (altho sometimes) distinctly one or the other variety. In southern Missouri and Arkansas *major* occurs in more nearly pure form. Further west, in the eastern part of Kansas, *major* seems to hybridize with *vorisi,* altho *vorisi* is on *Q. macrocarpa* and *major* seems confined to *Q. alba* except where *alba* is rare or lacking. We have a few specimens of what would appear to be hybrids of *major x gigas* on *Quercus Michauxii* and *Q. Mühlenbergii* in Missouri and Kansas.

I have numerous insects of *major* which emerged during the first season, but most of the insects I have bred waited until the second winter for emergence. The recorded emergence dates are November 22; December 1, 4, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 26, and 28; January 2, 3, 4, 5, 7, 8, and 20; February 2, 6, and 20, and even one case of emergence as late as April 25.

Cynips fulvicollis variety **gigas** (Weld)

agamic form

Figures 40, 229, 241, 250

Philonix gigas Weld, 1922, Proc. U.S. Nat. Mus. 61(18): 12, fig. 2. Weld, 1926, Proc. U.S. Nat. Mus. 68(10): 61.

Philonix nigra err. det. Weld, 1926, Proc. U.S. Nat. Mus. 68(10): 61 (Kans. record only).

FEMALE.—Head, including the bases of the antennae, usually bright rufous; thorax rich, bright rufous, darker rufo-piceous only in

places; the entire mesonotum closely punctate and very hairy; abdomen mostly black, the hairy patch on the second segment large, sometimes with scattering hairs on all the other segments laterally; legs largely bright to darker rufous; wings large, about 0.62 of the body in length, reaching beyond the second abdominal segment, broader and with a more complete venation than in other varieties of the species; large insects, 2.8 to 4.9 mm. in length. Figures 241, 250.

GALL.—As described for the species, larger than other varieties; prominently pubescent; up to 20.0 mm. in diameter; on the leaves of *Quercus lyrata, Q. Michauxii,* and *Q. Mühlenbergii.* Figure 229.

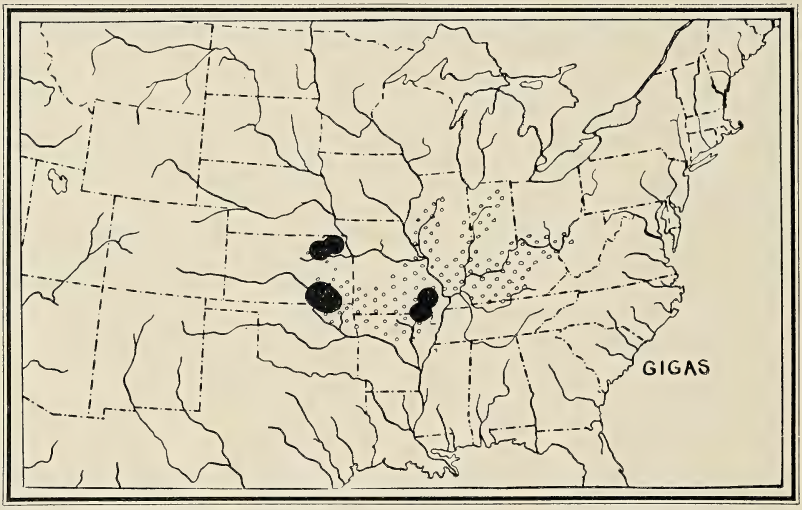


FIG. 40. OZARK VARIETY, C. FULVICOLLIS ON CHESTNUT OAKS
Possible extension of known range shown by shading.

RANGE.—Arkansas: Hoxie (Weld, *Q. lyrata,* types).
Missouri: Poplar Bluff (*Q. lyrata,* acc. Weld 1922).
Kansas: Manhattan and Holton (*Q. Mühlenbergii* acc. Weld, 1926). Riley County (Marlatt in Kans. Agric. College and Kinsey coll.). Arkansas City (*Q. Michauxii,* R. Voris in Kinsey coll.). Winfield, Cedarvale, Silverdale, and Dexter (*Q. Michauxii, Q. Mühlenbergii,* R. Voris in Kinsey coll.).

Probably confined to *Q. lyrata* and to chestnut oaks, in the Ozark area and its immediate extensions. Figure 40.

TYPES.—16 females and galls. Holotype and paratype females and galls at the U.S. National Museum (Cat. No. 24679); a paratype female in the Kinsey collection. From Hoxie, Arkansas; insects December 1, 1917, December 18, 1917, and March 24, 1919; *Q. lyrata;* L. H. Weld collector.

The present re-descriptions are based on my studies of all these types.

This is an Ozark variety which seems to be isolated from varieties *major* and *vorisi* of the same region by its host relations. The types of *gigas* came from *Q. lyrata* and I have many insects that appear to represent the same variety from *Q. Mühlenbergii* and *Q. Michauxii.* Gigas is closely related to *major* and *vorisi,* and occasionally the host restrictions fail and the three hybridize in eastern Kansas. Weld was correct in recognizing *lanaeglobuli,* from *Q. bicolor* in Florida, as another relative of *gigas.*

Weld found pupae in the galls on October 10 (in 1917) ; he found live adults in the galls on November 16. The Marlatt material from Riley County, Kansas, was bred in November and January. Weld's material bred out-of-doors at Evanston gave eight adults on December 1 and three more on December 18, the thermometer having registered —14° F. between those dates. He found other adults emerging in the next spring, and suggests that "emergence must be distributed over at least two or three seasons, for normal larvae were found when the last of the galls were cut open December 2", more than two years after collecting. Almost all of the insects I have bred emerged in the first winter after collection, only two emerging the second year in my breeding bags. My records for emergence are December 17, 20, 22, 23, and 24; January 4, 5, 7, and 9; and February 6.

Cynips fulvicollis variety **lanaeglobuli** (Ashmead) agamic form

Figures 240, 253

Acraspis lanaeglobuli Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128, 139. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 310. Dalla Torre, 1893, Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 412, 816, 828. Thompson, 1915, Amer. Ins. Galls: 16, 36.

Acraspis lanae-globuli Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 109.

Philonix lanaeglobuli Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 252. Beutenmüller, 1918, Ent. News 29: 328. Felt, 1918, N.Y. Mus. Bull. 200: 95. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 12.

FEMALE.—Head and thorax bright, rich rufous, a bit darker in only a few places; abdomen rufo-piceous or darker, mostly naked; wings about 0.65 of the body length, longer than in *fulvicollis,* but hardly

reaching more than half way along the second abdominal segment, with quite an incomplete venation; large insects, 4.7 mm. in length. Figures 240, 253.

GALL.—As described for the species, up to 8.7 mm. in diameter, averaging a little larger than other varieties except *gigas* and *vorisi;* on the leaves of *Quercus bicolor.*

RANGE.—Eastern Florida (Ashmead; types).

The data are insufficient to suggest further extensions of this range.

TYPES.—8 females and galls. Holotype and paratype females and galls at the U.S. National Museum; paratype females and galls at the Philadelphia Academy. From eastern Florida; *Q. bicolor;* Ashmead collector.

The present re-descriptions are based on my studies of all of the type material.

Nothing is known about this variety beyond the data with the type collection. The insect is distinct, and *nigra* and *gillettei* should not be made synonyms of *lanaeglobuli* as Beutenmüller would have them (1918). *Q. bicolor* galls which I have from New York (Staten Island) and New Jersey (Broadway) average near the size of the present variety, but until we can study insects from these localities we cannot suggest whether *lanaeglobuli* occurs thruout the Atlantic Coastal Plain or is confined to an area in Florida. The nearest relatives of *lanaeglobuli* are the Middle-Western *gigas* on *Q. lyrata* and the chestnut oaks, and *vorisi* on *Q. macrocarpa* and *Q. bicolor.*

Cynips **fulvicollis** variety **fulvicollis**

agamic form **fulvicollis** (Fitch)

Figures 41, 228, 234, 242-243, 252, 255

Philonix fulvicollis Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 783. Cresson, 1862, Proc. Ent. Soc. Phila. 1: 203. Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 353. Bassett, 1870, The Ent. 5: 111. Ashmead in Smith, 1900, Ins. N.J.: 548. Ashmead, 1903, Psyche 10: 148. Felt, 1906, Ins. Aff. Pk. and Woodl. Trees 2: 711. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26:254. Viereck, 1916, Hymen. Conn.: 381. Beutenmüller, 1918 (in part, not syn.), Ent. News 29: 328. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18) : 10, 12. Weld in Leonard, 1928, Ins. N.Y.: 971.

Philonix nigricollis Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 783. Cresson, 1862, Proc. Ent. Soc. Phila. 1: 201. Osten Sacken, 1865, Proc. Ent.

Soc. Phila. 4: 353. Ashmead in Smith, 1900, Ins. N.J.: 548. Felt, 1906, Ins. Aff. Pk. & Woodl. Trees 2: 711. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 254. Viereck, 1916, Hymen. Conn.: 381. Beutenmüller, 1918, Ent. News 29: 328. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 12. Weld in Leonard, 1928, Ins. N.Y.: 971.

Cynips (Teras) fulvicollis Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 379. Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.

Cynips (Teras) nigricollis Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 353, 379. Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.

Philonips fulvicollis Bassett, 1870, Trans. Ent. Soc. London 1870: XV.

Biorhiza fulvicollis Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296, 304. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 178. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 402.

Biorhiza nigricollis Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 178. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 402.

Acraspis niger Gillette, 1889, Iowa Agric. Exp. Sta. Bull. 7: 282. Gillette, 1890, Ent. Amer. 6: 23. Gillette, 1892, Proc. Iowa Acad. Sci. 1 (2): 113. Felt, 1906, Ins. Aff. Pk. & Woodl. Trees 2: 711. Thompson, 1915, Amer. Ins. Galls: 16, 36.

Biorrhiza nigricollis Dalla Torre, 1893, Cat. Hymen. 2: 61. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 56.

Acraspis nigra Dalla Torre, 1893, Cat. Hymen. 2:64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich 24:410, 810.

Biorrhiza fulvicollis Dalla Torre, 1893, Cat. Hymen. 2: 60. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 56.

Acraspis Gillettei Bassett, 1900, Trans. Amer. Ent. Soc. 26: 323. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58.

Acraspis gillettii Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 25.

Philonix gillettei Felt, 1906, Ins. Aff. Pk. & Woodl. Trees 2: 711.

Philonix nigra Beutenmüller, 1909 (in large part), Bull. Amer. Mus. Nat. Hist. 26: 251, pl. 43 figs. 12, 13. Cosens, 1912, Trans. Canad. Inst. 9: 342, 384, fig. 61. Weld, 1922 (in large part), Proc. U.S. Nat. Mus. 61 (18): 10, 12. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 61. Weld in Leonard, 1928, Ins. N.Y.: 971.

Philonyx fulvicollis Beutenmüller in Smith, 1910, Ins. N.J.: 598.

Philonyx nigricollis Beutenmüller in Smith, 1910, Ins. N.J.: 598.

Philonyx gillettei Beutenmüller in Smith, 1910, Ins. N.J.: 598. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 411. Thompson, 1915, Amer. Ins. Galls: 16, 35. Viereck, 1916, Hymen. Conn.: 380. Beutenmüller, 1918, Ent. News 29: 328. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 199.

Philonyx nigra Beutenmüller in Smith, 1910 (in part), Ins. N.J.: 598.

Acraspis nigricollis Thompson, 1915, Amer. Ins. Galls: 36.

Philonix niger Felt, 1918 (in part), N.Y. Mus. Bull. 200: 96.

Cynips fulvicollis var. A and C Kinsey, 1927, Field and Lab. Manual in Biol.: 108.

[NOT *Diplolepis niger* Fourcroy, 1785, Ent. Paris 2: 392—published as *Cynips nigra* by Dalla Torre, 1893, Cat. Hymen. 2: 73.]

[NOT *Biorhiza nigra* Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 782—published as *Cynips (Biorhiza) nigra* by Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.]

[NOT synonomy in Beutenmüller, 1918, Ent. News 29: 328.]

[NOT *Andricus fulvicollis* forms *bicolens* and *erinacei* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 353-356, 381, figs. 33, 34.]

FEMALES.—Higly variable insects, the head usually rich, dark rufous to black, darkest medianly; antennae brownish rufous, brighter basally, black apically; thorax rich rufous, darker to piceous or black in places especially anteriorly between the parapsidal grooves; mesonotum sparingly punctate and hairy, sometimes naked and shining posteriorly; abdomen rufo-piceous to black; the hairy patch on the second segment of limited extent; legs partly rufous to wholly rufo-brown, piceous, or black; wings averaging about 0.55 of the body in length, reaching three-quarters or more along the second abdominal segment, narrow, with reduced subcostal and basal veins and but mere traces of the other veins; moderate-sized insects 2.2 to 3.7 mm. in length. Figures 234, 242-243, 252, 255.

GALL.—Up to 10.0 mm. in diameter; naked to pubescent; on leaves, usually of *Quercus alba*, occasionally on *Q. Michauxii* (and *Q. macrocarpa?*). Figure 228.

RANGE.—Ontario: Toronto (Brodie in U.S. Nat. Mus.; also acc. Cosens 1912).

New Hampshire: Alton Bay (galls, Mrs. D. Tenney coll.).

Massachusetts: Forest Hills and Framingham (galls, Kinsey coll.).

Connecticut: probably Waterbury (Bassett coll.).

New York: near Albany? (Fitch, types of *fulvicollis* and *nigricollis*). New York City (Beutenmüller acc. Weld 1926). Riverhead (Crosby acc. Weld 1926). Ithaca (acc. Weld 1926).

New Jersey: Ft. Lee (Beutenmüller in American Mus. Nat. Hist.). Bennett (Kinsey coll.).

D. C.: Rock Creek (F. E. Mather in U.S. Nat. Mus.). Washington (H. S. Barber in U.S. Nat. Mus.).

Ohio: Columbus (galls, Kinsey coll.).

Michigan: Ionia Co.? (Gillette, types of *gillettei* and of *niger?*). Tekonsha, Owosso, Bay City and Traverse City (Kinsey coll.). Three Rivers (*Q. alba* and *Q. macrocarpa,* Kinsey coll.). Martin (gall, Kinsey coll.).

Indiana: Porter (acc. Weld 1926). North Webster, Winona Lake, Delphi, Mitchell, and Ontario (galls, Kinsey coll.). Crawfordsville (E. C. Stout and Hugh Lee in Kinsey coll.). Steubenville, Huntington, Bloomington, 10 miles southeast of Bloomington, 7 miles east of Bloomington, Linton, Clinton, and Bedford (Kinsey coll.). Ft. Wayne (C. M.

Kinsey coll.). Nashville and Spencer (*Q. alba* and *Q. Michauxii,* Kinsey coll.). Letts (*Q. Michauxii,* E. B. Ruth in Kinsey coll.). Charlestown (H. Spieth in Kinsey coll.).

Illinois: Evanston, Glencoe, Glen Ellyn, and Fountaindale (acc. Weld 1926). Oakwood, Oakley, and Urbana (A. E. Miller in Kinsey coll.). Danville (galls, W. V. Balduf in Kinsey coll.). Eddyville (O. Buchanan in Kinsey coll.). West Union, Norris City, Olney, Bonnie, Bloomfield in Johnson County, and America (Kinsey coll.). Pana (galls, Kinsey coll.).

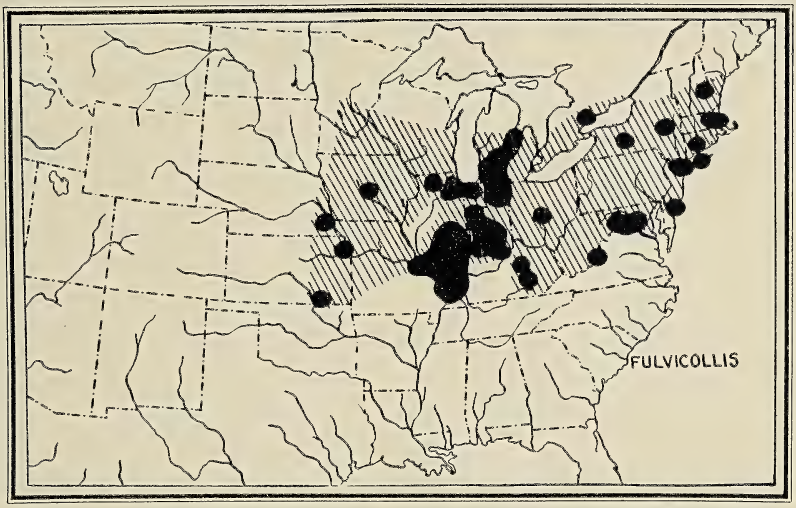


FIG. 41. NORTHEASTERN VARIETY, C. FULVICOLLIS ON Q. ALBA

Probably of post-Pleistocene origin, hybrid of more northern and more southern varieties.

Kentucky: Paducah, Wickliffe, Dawson Springs, and Pinehill (Kinsey coll.). Cleveland (gall, Kinsey coll.).

Virginia: Bluemont (acc. Weld 1926). Blue Ridge Mts. near Natural Bridge Station, and Winchester (Kinsey coll.).

Iowa: Corinth (C. Barracks coll. acc. Weld 1926). Ames? (Gillette coll., types of *gillettei?* Also material of *niger* in U.S. Nat. Mus.).

Nebraska: Nebraska City (acc. Weld 1926).

Missouri: Kimmswick (acc. Weld 1926). St. Louis and Allenton (galls, E. S. Anderson in Kinsey coll.). Rankin (Kinsey coll.).

Kansas: Dexter (*Q. Michauxii,* R. Voris in Kinsey coll.). Leavenworth (galls in Kinsey coll.).

Apparently thruout the northeastern United States and adjacent Canada, westward to Nebraska, southward to Kentucky and Kansas. The variety appears to be a hybrid of *major x canadensis,* and since there are many forms of intergrades between these and *fulvicollis,* the extreme locality records are open to question. Figure 41.

TYPES.—Of *fulvicollis:* 4 females in the U.S. National Museum. Taken on snow late in November and early in December, before 1859; probably from near Albany, New York; Asa Fitch collector.

Of *nigricollis:* 1 female in the U.S. National Museum. The insect collected on snow at some date before 1859; probably from near Albany, New York; Asa Fitch collector.

Of *gillettei:* numerous females and galls. Holotype and paratype females and galls at the Philadelphia Academy, paratype females and galls in the American Museum and the Kinsey collections. From Ionia County, Michigan, *or* from Ames, Iowa; *Q. alba;* C. P. Gillette collector.

Of *niger:* two females in the U.S. National Museum. Probably from Ionia County, Michigan; *Q. alba;* C. P. Gillette collector.

The present re-descriptions are direct studies of the holotypes and of all the paratypes of *fulvicollis, nigricollis, gillettei,* and *niger.* The variety appears to be of hybrid origin, and is consequently so variable that the holotypes and small type series are of little value in establishing any conception of the variety.

This is the common variety on the white oaks of the northeastern quarter of the United States and adjacent Canada. It is possible that *fulvicollis* is replaced on the Atlantic Coastal Plain by a distinct variety. The southern Indiana material that is available shows gradation toward the variety *major* of the more southern Middle West. True *fulvicollis* is rare south of the Ohio River, except in the eastern mountains of Kentucky and still further south in the Blue Ridge.

The host of *fulvicollis* is usually *Q. alba.* Nevertheless I have four insects that appear to be *fulvicollis* from *Q. Michauxii* from Letts and more insects from the same host from Nashville in southern Indiana and from *Q. macrocarpa* in southern Michigan. Gillette recorded both *Q. alba* and *Q. macrocarpa* as hosts in "Michigan and Iowa." Ashmead's record (1885:304) for this insect on the chestnut oak, *Q. montana,* is open to re-determination.

The galls of *fulvicollis* begin developing in mid-summer (July 4 at Bloomington, Indiana, in 1929), but galls at Winona Lake in northern Indiana on August 12 (1927), and further south at Spencer, Indiana, on September 11 (in 1926) were still small, succulent, and almost solid, without differentiation of the fibers which later support the larval cell. Galls from central Illinois (Urbana) were full size but succulent and with very small larvae on August 18 (1927). The gall makers begin to emerge at the beginning of either the first or the second winter, but mostly in the second season. Fitch

found his type material running about on the snow. He thought the insects had come from root galls, but in this he was, of course, mistaken. Other breeding records range from early November to the latter half of February. Brodie secured adults at Toronto on November 10, 18, 20, and 24 (1886 to 1899, acc. U.S. Nat. Mus. coll.) and December 5 (in 1903 and 1907). From material collected in October at Glencoe, Illinois, Weld secured two adults before November 23 and five before December 11 (in 1916). Weld also gives November 1 to 19 (in 1917), December 2 (in 1919), and February 19 as dates on which adults were secured. F. E. Mather secured active adults at Washington on December 25 (in 1908). My own breeding records, scattered over several years, are for November 16 and 22; December 1, 4, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 26, 28, and 30; January 1, 2, 3, 4, 5, 6, and 8; and February 2. Very little of this emergence occurs during the first year, practically all of it occurring during the second winter after the development of the gall.

Some colonies of galls are very heavily parasitized; other colonies yield a remarkably high percentage of gall makers. Parasites commonly emerge from the galls from late August until November of the first season, and again in abundance during the following April, May, and June.

The eggs of the agamic form of *fulvicollis* are apparently layed in the unopened buds of the white oaks, for Bassett's *pallipes,* which produces a seed-like gall that develops in these buds in the next spring, is apparently the alternating, bisexual generation of *fulvicollis.*

Fitch first drew attention to a perceptible ant or bee odor which is given out by the agamic gall maker of this species.

Cosens (1912) shows a section of a larva of this variety that indicates there is an external opening to the digestive tract posteriorly. His account of the histologic structure of this gall is quoted under the specific description of *fulvicollis* in the present publication.

Altho *fulvicollis* is one of the oldest names among American Cynipidae, Fitch's meager description went uninterpreted for nearly sixty years. Beutenmüller then found the types at the U. S. National Museum, but unfortunately considered them the "same as" his *erinacei.* I uncritically followed this synonomy in my paper (1920) on the life histories of American Cynipidae. A few years ago Weld studied these types and con-

cluded that *fulvicollis* is a *Philonix* while *erinacei* is an *Acraspis.* My recent studies in the U. S. National Museum lead me to agree with Weld's interpretation. At the same time, direct comparison of the holotype and paratypes of *fulvicollis* and *nigricollis,* of paratypes of *gillettei,* and of the holotype of Gillette's *niger* leads me to conclude that all these names are synonyms. Each holotype is different from any of the others, but every variation covered by the types, and many additional variations are included in every extensive series we have represented in our collections.

What we appear to have here is a highly variable complex that grades into variety *canadensis* to the north and variety *major* to the south. In the intermediate territory, which is much of the northeastern quarter of the United States, one finds *canadensis* and true *major* and every conceivable intergrade between the two. The intermediate types are everywhere the most abundant. As one goes north, true *canadensis* or hybrid individuals appearing to have a great deal of *canadensis* blood are predominant. Toward the south, *major* similarly asserts itself.

One examining several thousand insects of this remarkable complex cannot doubt its hybrid origin from *canadensis x major.* The chief question to be raised is whether we are warranted in calling such a heterogeneous population a species. It is much like *Cynips pezomachoides erinacei* which also seems hybrid in origin, and the same geologic history that explains (p. 398) the origin of *erinacei* should fit *fulvicollis.* The two occur in the same area. In both cases the northern variety probably met its opportunity to hybridize with the southern variety upon the advance of the Pleistocene glaciers, and the retreat of the glaciers offered an extensive territory for the isolation and development of the hybrid. *Fulvicollis* is not as thoroly fused as *erinacei.* Nevertheless, the widespread distribution of the complex may warrant its recognition as a distinct taxonomic unit, whatever we may choose to call it.

The individuals which are the types of *nigricollis, niger,* and *gillettei* are only larger or smaller, lighter or darker, more hairy or less hairy representatives of this *fulvicollis* complex, and not nearly as diverse forms as a larger series of true *fulvicollis* will show.

Cresson's list of the Bassett types in the Philadelphia Academy states that *gillettei* came from Fort Collins, Colorado.

This probably represents an attempt to interpret Bassett's original record which read: "from the ground beneath a large white oak on his [C. P. Gillette's] lawn." Professor Gillette has recently written me that he is not now positive of the locality from which he obtained the type material of *gillettei*, but he believes the galls "were taken either at my old home in Ionia County, Michigan, where there was a white oak tree of considerable size in our dooryard, or on the campus of the Iowa Agricultural College. . . . I do not recall any white oak near the house in which we lived on the Ames campus." If the present species is ever found as far west as Colorado, it should be represented by a variety distinct from any now known from the more eastern areas.

Cynips fulvicollis variety **fulvicollis**
bisexual form **pallipes** (Bassett)

Figures 41, 231, 232, 233, 245, 251

Dryophanta pallipes Bassett, 1900, Trans. Amer. Ent. Soc. 26: 327. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Felt, 1906, N.Y. Mus. Mem. 8 (2): 710. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 358, pl. 16 figs. 5, 6. Thompson, 1915, Amer. Ins. Galls: 11, 38. Viereck, 1916, Hymen. Conn.: 398. Felt, 1918, N.Y. Mus. Bull. 200: 74, fig. 65 (5, 6). Britton, 1920, Checklist Ins. Conn.: 320. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 200.

Diplolepis pallipes Dalla Torre and Kieffer, 1910, Das Tierreich 24: 358, 807, 825.

FEMALE.—Head, thorax, and abdomen for the most part jet black; the antennae dark brown with the first three to five segments bright yellow; the legs light yellow except on the hind coxae which are piceous basally; the mesonotum smooth, naked, and very shining, sometimes slightly wrinkled between the parapsidal grooves, coriaceous to finely rugose just outside the parapsidal grooves and more rugose at the anterior end of the grooves, the grooves however continuous; the anterior parallel and lateral lines and median groove absent; the entire scutellum finely rugose and finely hairy; the ridge separating the scutellum from the rest of the mesonotum perfectly distinct; the mesopleuron entirely smooth and shining and practically naked; the wings 1.17 times the body length, with the second abscissa of the radius fairly straight and ending in an abruptly bent tip; the radial cell rather long but not narrow; the cubital cell with a faint blotch basally and fainter marks apically; body length 2.3 to 2.5 mm. Figures 233, 245, 251.

MALE.—Differing from the bisexual female as described for the genus. The antennae with two or more of the basal segments yellow; body length 2.5 to 2.8 mm. Figure 232.

GALL.—A rather elongate but still broadly egg-shaped cell with one end (the base) truncate, flat; reddish-brown and dark brown in color; the surface all but microscopically smooth; the cell wall thin, hard and brittle, occasionally with more than one layer (as several bud scales become involved in the gall); entirely empty, without a separate larval cell; up to 3.5 mm. in length. Buried inside otherwise unmodified buds, or deforming and dwarfing clusters of leaves which become slender and thread-like about the gall; on *Quercus alba.* Figure 231.

RANGE.—Probably the same as that of the corresponding agamic form which occurs everywhere on *Q. alba,* from Massachusetts to Iowa and the Ohio River Valley (fig. 41). The bisexual form known definitely only from:

Connecticut: Waterbury (Bassett, types).
New York: state (acc. Beutenmüller 1911).
New Jersey: state (acc. Beutenmüller 1911).
Pennsylvania: state (acc. Beutenmüller 1911).
Indiana: Charlestown (E. W. Spieth in Kinsey collection).

TYPES.—A holotype female, one paratype female, one male, and galls in the Philadelphia Academy. From Waterbury, Connecticut; *Q. alba;* Bassett collector.

The present re-descriptions are based on my studies of all this type material, and on comparisons with my southern Indiana series of insects and galls.

These bisexual insects have been previously known only from Bassett's very scant collection and from Beutenmüller's records for which I have not seen material. I have secured 16 insects and numerous galls from southern Indiana by bagging large numbers of unopened buds of *Q. alba* in the early spring. By this method the bisexual form *(bicolens)* of *Cynips pezomachoides erinacei* is also likely to be obtained, but our present insect may be distinguished from *bicolens* by the characters given in this study.

Bassett's original description was introduced as follows: "The rapid Spring growth of thrifty young white oak shoots is sometimes suddenly checked by the appearance of this gall at their apex. The gall does not prevent the development of the leaves below it, but immediately surrounding its base half a dozen or more brown, thread-like bodies from three-fourths of an inch to an inch and a half in length appear. Occasionally two or more of these are narrowly strapped shape, and suggest that they are all undeveloped leaves. . . . The insect emerges from the apex of the cell, leaving it resembling an eggshell with the end removed."

The date of appearance of the adult insect will vary as the latitude and season may affect the development of the buds of the oaks in the region. In southern Indiana adults were emerging from the galls on April 22 and May 1 in 1927. Bassett did not find the galls appearing in Connecticut until early May, while the insects emerged later in May.

This insect has gone uninterpreted since Bassett's original discovery, but the following considerations now seem to lead to our conclusion that this is the bisexual form of no less common an insect than *Cynips fulvicollis fulvicollis.*

The insect shows the generic characters of a bisexual *Cynips* as established by the life histories experimentally determined (*folii, divisa,* and *erinacei*) in the genus.

Pallipes is undoubtedly the alternate of some eastern American species of agamic *Cynips* for which at least some variety is already described. No Eastern species of *Cynips* (as categories are used in this paper) has been added to our list since 1882, altho new varieties are still being discovered.

The only agamic *Cynips* known east of the Mississippi River are *fulvicollis, centricola, mellea, villosa, gemmula, pezomachoides,* and *hirta.*

Centricola is strictly confined to *Quercus stellata,* an oak so distinct from *Q. alba* that no white oak insect like *pallipes* is likely to prove the alternate of *centricola. Pallipes* has a wing-body ratio averaging 1.17 while in *centricola* the ratio is 1.35. This difference is noticeable to the naked eye, and quite constant upon precise measurement.

Hirta and *gemmula* are confined to the chestnut oaks and *Q. macrocarpa. Pallipes* cannot represent the *Q. alba* branch of the *hirta-gemmula* stock because *Cynips pezomachoides* is certainly that *Q. alba* branch; and *bicolens,* the experimentally determined bisexual form of *pezomachoides,* is at least specifically distinct from *pallipes.*

Indeed, *pallipes* is more remote from *bicolens,* for its hypopygial spine is distinctly broader and its wing-body ratio is not above 1.17. In a long-winged *Acraspis* it should be 1.30. It should again be emphasized that this ratio is one of the most constant of generic or subgeneric characters among Cynipidae, except in cases where the wings are distinctly aborted. The wing of *pallipes* is not aborted, for the venation is perfectly normal and without the shortening of the radial cell

which is the first sign of wing mutation among Cynipidae. 1.17 may be taken as the ratio characteristic of the subgenus to which *pallipes* belongs.

The wing-body ratio in *pallipes* rules the other species of *Acraspis*, namely, *villosa* and *mellea* out of consideration as alternates.

Villosa is further ruled out by having *Q. macrocarpa* as its only eastern American host.

Mellea is further ruled out by its nearly simple tarsal claw. The claw of *pallipes* is toothed. Moreover, *mellea* varieties have an entirely clear cubital cell, and they rarely occur on *Q. alba*.

The only eastern American *Cynips* left for consideration as a possible alternate of *pallipes* is some variety of *fulvicollis*. *Fulvicollis* and *pezomachoides* are the only *Cynips* common on *Q. alba* in the northeastern quarter of the United States.

Nothing in the structure or the life history data precludes the consideration of *pallipes* as the alternate of *fulvicollis* unless it is the hypopygial spine. The spine of *pallipes*, while broader than in *Acraspis* or *Atrusca*, is more elongate ventrally than in the short-winged, agamic forms of *Philonix fulvicollis*. We have, however, some experience that may clear up this difficulty over the spine, for the spine of the short-winged, agamic *Acraspis* is almost always blunt and even truncate, while the spine of the bisexual form is slender.

Finally, the position of *pallipes* in *Philonix* is further confirmed by our recognition of *Cynips plumbea* (*q.v.*) of the Southwest, as a species of *Philonix*. The wing-body ratio of *plumbea* is 1.17, precisely the ratio for *pallipes*. The hypopygial spines of *plumbea* and *pallipes* are also subgenerically related.

Cynips (Philonix) fulvicollis is an exceedingly common insect over a wide area of the eastern United States, and its bisexual forms should, at any rate, be insects as common and as easily secured as the *pallipes* material we have recovered during the past year.

It remains to add that if *pallipes* belongs to the species *fulvicollis*, it must represent the variety *fulvicollis*, for the types of *pallipes* came from southern Connecticut which is well within the range of the agamic *fulvicollis*.

Cynips fulvicollis variety **canadensis,** new variety agamic form

Figures 42, 244, 254

FEMALE.—Body almost entirely black, with some touches of rufopiceous, the antennae and legs entirely brown; mesonotum largely smooth and naked in the center, sparingly punctate and hairy anteriorly and laterally; the hairy patch on the second segment of very limited extent; legs brownish to dark brown and piceous; wings small, averaging 0.40 of the body in length, with only traces of veins in the terminal half of the wing; very small insects 1.7-3.0 mm. in length. Hybrids grade into the more rufous, more hairy, and larger insect *fulvicollis.* Figures 244, 254.

GALL.—As described for the species; often smooth, shining, and naked, with very little pubescence; the typical galls averaging about 6.0 mm. in diameter; on leaves of *Quercus alba.* Rarely on *Q. Michauxii, Q. Mühlenbergii* and *Q. macrocarpa* in the more southern extension of the range.

RANGE.—Michigan: Traverse City (types, Kinsey coll.). Bay City, West Branch (galls, Kinsey coll.). Owosso (Kinsey coll.). Pentwater (gall, F. Payne in Kinsey coll.). Interlochen (galls, R. Voris in Kinsey coll.).

Indiana: Fort Wayne, Huntington, Nashville, and Clinton (Kinsey coll.). Morocco (*Q. macrocarpa,* Kinsey coll.). Spencer (*Q. Michauxii,* Kinsey coll.).

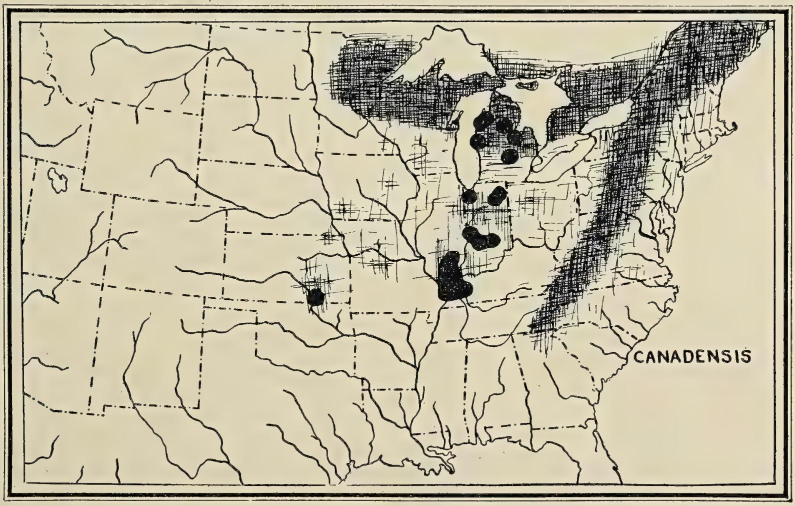


FIG. 42. SUB-CANADIAN VARIETY, C. FULVICOLLIS
Southern extensions of range effected by Pleistocene glaciation.

Illinois: Olney, Bonnie, Norris City, Bloomfield in Johnson County, and America (Kinsey coll.). West Union (*Q. alba* and *Q. bicolor*, Kinsey coll.).

Kentucky: Paducah and Dawson Springs (Kinsey coll.).

Kansas: Winfield (*Q. Mühlenbergii, Q. macrocarpa*, Voris in Kinsey coll.). Cedarvale (*Q. Mühlenbergii*, Voris in Kinsey coll.).

Probably thruout the sub-Canadian area of the northeastern quarter of the United States, still surviving in fairly pure form and as hybrids with varieties *fulvicollis* or *major* as far south as southern Illinois and the Kentucky mountains. Beyond the area covered by our collections, it is to be expected in northern New York, New England, and southeastern Canada. Figure 42.

TYPES.—84 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the U.S. National Museum, the American Museum of Natural History, the Museum of Comparative Zoölogy, the Field Museum, the California Academy, and Stanford University. Labelled Traverse City, Michigan; galls October 3, 1927; insects November 16 and December 10, 1928; *Q. alba;* Kinsey collector. From the same locality we also have material which inter-grades into variety *fulvicollis*. The holotype of *canadensis* is one of the smaller, more uniformly black, and least hairy individuals of the type series.

This is the most northern variety of the species, best represented at present from the northern end of the southern peninsula of Michigan, but to be expected everywhere where white oak occurs along the Canadian-United States boundary. There seems every reason to believe that this insect was pushed southward with the advance of the Pleistocene glaciation, and that variety *fulvicollis (q.v.)* is a hybrid of *canadensis x major*. If this interpretation is correct, it explains why fairly typical *canadensis* still occurs in small numbers as far south as southern Illinois, southern Indiana, and the hill country of Kentucky. We even have material from southeastern Kansas, but this determination may be open to question. The influence of *canadensis* in the *fulvicollis* complex increases considerably in northern Indiana and southern Michigan, but no considerable percentage of pure individuals of *canadensis* is to be found until one reaches more northern Michigan. The insect that Fitch described (1859) as *nigricollis* would appear to be an individual of *fulvicollis* carrying considerable *canadensis* blood.

Canadensis is all but confined to the white oak, *Quercus alba*. The mature galls are on the ground by the last of September where they lie, in the north, thru the severe winter and the following year until emergence occurs in the second and even

third winter after the galls started growth. Only stray individuals emerged the first year after collecting our more northern material, and it is not certain that these did not come from old galls gathered with the new crop. On the other hand, all of our Kansas insects emerged the first year after collecting. If our determinations are correct, these data raise an interesting question as to the factors affecting emergence. Direct temperature affecting the developing larvae cannot be responsible for the date of emergence of the insects, for Michigan material kept in the mild climate of southern Indiana for thirteen months emerged in the middle of November, and Kansas material placed in the same breeding box outside our laboratory windows emerged from late December to late January—in both cases near the dates they would have emerged in the normal environments.

Our emergence dates for this insect are November 16; December 1, 4, 8, 10, 16, 18, 20, 22, 28, and 30; and January 4, 5, 8, and 25. The emergence of the material from northern Indiana and Michigan ranged from November 16 to December 20; that of the more southern collections began on December 4, but was concentrated chiefly between December 12 and January 25.

Cynips subgenus **Atrusca**, new subgenus agamic forms

Dryophanta Mayr, 1881 (in part), Gen. gallenbew. Cynip.: 35. Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 370-371. Dalla Torre, 1893 (in small part), Cat. Hymen. 2: 48. Dalla Torre and Kieffer, 1902 (in part), Gen. Ins. Hymen. Cynip.: 52. Beutenmüller, 1911 (in part), Bull. Amer. Mus. Nat. Hist. 30: 343-352. Also of other authors.

Loxaulis of one assignment: Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296.

Diplolepis Dalla Torre and Kieffer, 1910 (in part), Das Tierreich 24: 342. Weld, 1926 (in small part), Proc. U.S. Nat. Mus. 68 (10): 18-23. Also of other assignments and other authors.

Cynips of some assignments of early authors.

Holcaspis of some assignments of authors.

Disholcaspis of several assignments of authors.

Andricus of two assignments (Ashmead, Kinsey).

FEMALE.—The cheeks hardly at all enlarged behind the eyes; antennae of moderate length, shorter in all forms with shortened wings; with (rarely) 13 or (usually) 14 segments; the thorax of moderate size, smaller in shorter-winged varieties; parapsidal grooves continuous; median groove lacking; mesopleuron entirely punctate; abdomen entirely smooth and naked except for the hairs latero-basally; hypopygial spine rather long, slender, bluntly pointed, somewhat but not greatly widened well back from the tip; tarsal claws rather slender, broadened basally but only weakly toothed (more distinctly toothed in *centricola*); wings long, about 1.35 times the body in length; or wings shortened to 1.15, 0.90, or 0.85 times the body in length; if the wings are long, the second abscissa of the radius is well curved for its entire length (less curved in *centricola*), more strongly curved terminally, the tip of the vein angulated and swollen, the radial cell distinctly short and broad (longer in *centricola*) and with or without spots, the areolet very small to large, the cubital cell with a clouded patch basally and numerous spots apically, and the discoidal cell with or without patches or spots; in shorter-winged varieties the venation is reduced but all the veins are represented; length 2.0 to 4.5 mm., averaging rather large but not stout (except in *centricola*).

GALL.—Large, strictly spherical unless drawn out basally or abnormally distorted; entirely smooth and naked unless for a puberulence or microscopic pubescence; the outer walls of the gall thin, soft and pliable when moist, hard and brittle when dry, bright rose red and green when young, with or without spots, becoming light rose brown when older; the gall entirely hollow except for the thick-walled, centrally placed larval cell and for a moderate number of fine, silky, radiating fibers that connect the larval cell and the outer walls of the gall.

Attached singly or in groups (not clusters); on the upper or under surfaces of the leaves of the *Q. stellata* and *Q. alba* groups of white oaks of the eastern United States and the evergreen white oaks of the Southwest and Mexico.

RANGE.—Known from New York to Florida, Arizona, and central Mexico; the center of known distribution in our Southwest. Figure 43.

SUBGENOTYPE.—*Cynips dugèsi simulatrix,* new variety. Present designation.

FIG. 43. KNOWN RANGE, SUBGENUS ATRUSCA
Shading and figures indicate number of species known from each area.

Three species *(cava, dugèsi,* and *bella)* restricted to our Southwest, and one species *(centricola)* ranging in the eastern half of the United States as far north as Missouri and New York, constitute the known representatives of this subgenus. There are twelve described varieties. The known occurrence of one variety of *dugèsi* in more central Mexico, and the regular inclusion of galls that may represent this subgenus among the few collections that have come out of Mexico, suggests that the mountains in that country may hold many species of *Atrusca* still to be discovered. The attractively spotted wings of all the species of this group were, I must admit, one of the things that first attracted my attention to the present genus of gall wasps.

Atrusca is closest to the subgenus *Acraspis,* from which it

is separated by its slightly greater wing-body ratio, shorter radial cell due to the more strongly curved second abscissa of the radius, and its more elongate hypopygial spine. The uniform galls—all of them thin-shelled, spherical, hollow oak apples in which the larval cell is supported by relatively few, radiating fibers — testify to the unity of the group. The eastern species *centricola* is rather remote in insect characters from the three southwestern species.

The subgenus is of much interest because four of the twelve varieties have wings that are of reduced length, the reduction however being only fifteen, thirty-five, and thirty-seven per cent of the length normal for the subgenus.

The subgenus is of further note because the galls of all the varieties of the two species *bella* and *dugèsi* are identical.

We have not recognized the bisexual form of any variety of *Atrusca.*

Cynips (Atrusca) dugèsi (Mayr)

agamic forms

FEMALE.—The head rufous or darker, the antennae dark brown, more rufous basally; thorax not particularly large, bright or dark rufous, in some varieties darker to black in places; anterior parallel lines often evident, more often nearly obliterated; lateral lines not wide, quite evident; scutellum moderately rugose, smoother anteriorly, slightly raised on the mid-line, with two rather deep, more or less definite foveae; the hypopygial spine longer, more slender than in *bella;* wings long or short, from 1.35 to 0.85 of the body in length; the first abscissa of the radius without a projecting point; the second abscissa of the radius with or without an enlarged tip; with large, smoky patches about the base of the cubitus and at the base of the cubital cell; darker brown spots of irregular shape in the cubital cell, these spots often coalescing into a few irregular blotches; a much lighter, more indefinite cloud in the discoidal cell; the radial cell unspotted; length 2.0 to 3.2 mm.

GALL.—Thin-shelled, spherical, sessile, dull brown, unspotted, averaging 16.0 mm. in diameter, with the larval cell held centrally by fine, radiating fibers. Apparently not to be distinguished from galls of *Cynips bella (q.v.).* On the leaves of practically all of the white oaks of the regions in which the several varieties occur. Figure 197.

RANGE.—Southern Colorado and West Texas to Central Mexico; probably further south as far as white oaks extend. Figure 44.

This species, together with *Cynips bella,* produces the common oak apple gall of our Southwest. The galls of all the va-

rieties of both these species are indistinguishable, and the insects alone can be depended upon for determinations. The detailed discussion of this point in the introduction to *Cynips bella,* as well as all of the other data pertaining to the galls and the life history data for *bella* will apply to the present species.

Dugèsi is now known from four varieties, one found in

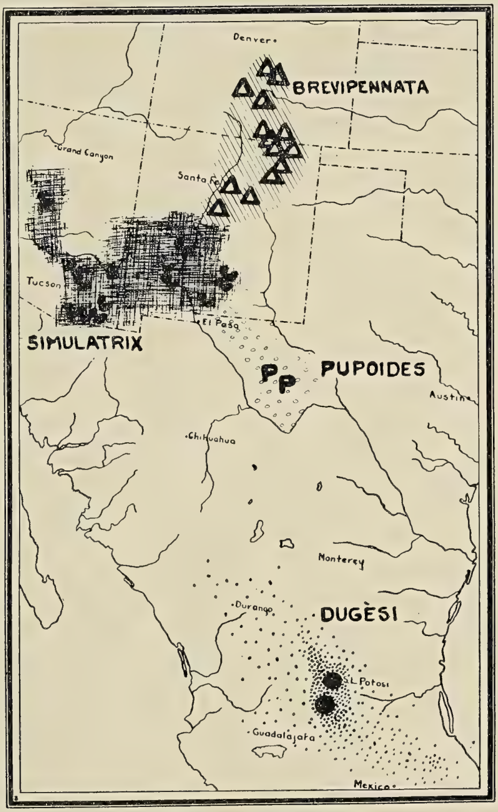


FIG. 44. VARIETIES OF CYNIPS DUGÈSI
Showing geographic isolation of related insects.

southern Colorado and northern New Mexico, one in southern New Mexico and Arizona, one in the mountains of West Texas, and one in central Mexico. I have broken material of another variety from the Apache Trail country of Arizona. Houard (1927, Marcellia 23: 99) reports galls from Guatemala which are said to resemble *dugèsi* galls, and the species probably extends that far south, altho we must await insects for verification of the determination.

The only one of these varieties with full-length wings is *simulatrix,* of southern Arizona and New Mexico. Variety *dugèsi* has a fifteen per cent reduction in the wing length, which is the same as the reduction in the related species *cava.* This shortening is distinct but so slight as to readily pass unnoticed; and *dugèsi* and *cava* are the only species of *Cynips* in which there is any wing reduction less than forty per cent of the length normal for the subgenus. Two other varieties of *dugèsi,* namely *pupoides* and *brevipennata* from southern Rocky Mountain areas in West Texas, northern New Mexico, and southern Colorado, have the wings reduced thirty-three and thirty-seven per cent, this reduction being marked, altho all of the veins are still represented in the reduced wings. The modifications of the proportions of the thorax are slight altho evident.

Cynips dugèsi variety **simulatrix,** new variety

agamic form

Figures 44, 263, 264, 266, 276, 287

Cynips dugèsi var. C Kinsey, 1927, Field and Lab. Manual in Biol.: 110.

FEMALE.—Head dark rufous, darker to black over much of the face; antennae dark brown, dark rufous on the first two segments only; thorax rufous to dark rufous, darker to black in many places; the abdomen mostly piceo-black, only limitedly rufo-piceous; the legs wholly dark rufous, brightest basally; head somewhat narrower than the thorax; parapsidal grooves moderately convergent at the scutellum; foveae largely smooth but sparingly, irregularly sculptured at bottom; **wings long,** 1.35 of the body in length, extending for half their length beyond the tip of the abdomen; first abscissa of the radius distinctly angulated at something more than 90°; second abscissa of the radius ending in a (usually) rather large, angulated tip; radial cell short but distinctly longer than wide; areolet large to very large, elongated on the cubitus; the spots well removed from the basal blotch in the cubital cell; length 2.8 to 3.2 mm., distinctly larger than the other varieties of the species. Figures 264, 266, 276, 287.

GALL.—As described for the species. Apparently not to be distinguished from other varieties of *dugèsi,* nor from *Cynips bella bella* which occurs in the same region. On leaves of *Quercus undulata, Q. grisea, Q. oblongifolia, Q. arizonica, Q. Gambelii,* and probably related oaks. Figure 263.

RANGE.—New Mexico: Magdalena (*Q. grisea,* acc. Weld in Kinsey coll.). Near Alamogordo at 7000 ft. (galls, *Q. undulata* and *Q. arizonica,* Kinsey coll.). Highrolls (galls, *Q. undulata,* Kinsey coll.).

Hillsboro (types, *Q. grisea,* Kinsey coll.). Kingston (galls, *Q. grisea* and *Q. Gambelii,* Kinsey coll.). Soledad Canyon in Organ Mts. (galls, *Q. grisea,* L. H. Bridewell in Kinsey coll.).

Arizona: Prescott (*Q. grisea,* Kinsey coll.). Safford, Oracle, and Bisbee (galls, *Q. arizonica,* Kinsey coll.). Sabino Trail in Santa Catalina Mts. and Santa Rita Mts. (*Q. oblongifolia* and *Q. arizonica,* Kinsey coll.). Courtland and Fort Huachuca (*Q. arizonica,* Kinsey coll.).

Probably confined to the desert mountain ranges of New Mexico and Arizona (and adjacent Mexico?). Records based on galls alone may involve confusion with *Cynips bella bella.* Figure 44.

TYPES.—14 females (several specimens broken) and galls (confused with galls of *C. bella*). Holotype and paratype females and galls in the Kinsey collection. Paratype females in the Museum of Comparative Zoölogy, the American Museum of Natural History, and the U.S. National Museum. Labelled Hillsboro, New Mexico; December 26, 1919; *Q. grisea;* Kinsey collector.

This variety, with *Cynips bella* variety *bella,* produces the common oak apple of our Southwest. Most of the insects had emerged before I collected the galls in New Mexico late in December (1919) and in Arizona in January (1920), but one female emerged at Prescott, Arizona, as late as January 23. The available insect material represents a wide geographic range and a surprising number of hosts, apparently without the isolation of distinct varieties.

The single, broken insect which I have of this species from Globe, Arizona, does not agree with typical *simulatrix,* but the specimen does not warrant description. On the basis of data from other cynipids, we might expect a distinct variety of *dugèsi* in the Pinal Mountains near Globe.

Cynips dugèsi variety **dugèsi** (Mayr)

agamic form

Figures 44, 268, 277

Dryophanta Dugèsi Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 370, pl. 12 fig. 1a, 1b, 2. Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52:290. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52.

Dryophanta dugesii Dalla Torre, 1893, Cat. Hymen. 2: 50.

Dryophanta Dugesii Kieffer, 1901, André Hymén. d'Europe 7 (1): 621.

Diplolepis dugesi Dalla Torre and Kieffer, 1910, Das Tierreich 24: 344, 355, 811, figs. 76-77.

Dryophanta Dugesi Küster, 1911, Die Gallen der Pflanzen :170.

Dryophanta dugesi Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 345, pl. 12 figs. 6-7. Felt, 1918, N.Y. Mus. Bull. 200: 98, fig.

97 (6-7). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: pl. 32 fig. 25.

FEMALE.—Head (including the basal halves of the antennae), thorax, legs, and abdomen bright brownish rufous, darker to rufo-piceous in only a few places; head about as wide as the thorax; parapsidal grooves moderately convergent at the scutellum; foveae entirely smooth at bottom; **wings slightly shortened**, 1.15 of the body in length, extending well beyond the tip of the abdomen; first abscissa of the radius angulate at more than 90°; second abscissa of the radius only slightly enlarged but still angulated at the tip; radial cell short but rather longer than wide; areolet of moderate size; the spots in the cubital cell well removed from the basal blotch in the cell; length 2.1 to 3.3 mm. Figures 268, 277.

GALL.—As described for the species, galls thus far collected being rather small (up to 15.0 mm. in diameter), with dull surfaces; on leaves of *Quercus mexicana* and other white oaks.

RANGE.—Mexico: San Luis Potosi (Ed. Palmer, in M. C. Z. and Kinsey coll.). Mts. of Guanajuanto (Dugès in U.S.N.M.).

Probably confined to an area in more central Mexico. Figure 44.

TYPES.—3 females in the Vienna Museum (acc. F. Maidl in litt.). From Mexico (locality not given); on *Quercus mexicana;* Dr. Dugès collector. Insects and galls from the same collector, from the Mts. of Guanajuanto, are in the U.S. National Museum.

I have examined this material in the National Museum.

Mayr gave *Q. mexicana* as the host of the type material, and his illustration more nearly matches *mexicana* than the black oak, *hypoleuca,* to which Beutenmüller referred it. My specimens were on an oak more closely related to *Q. oblongifolia* (which it is not). *If* Mayr's host reference is correct, then *mexicana* is a white oak and not a black oak as Trelease lists it (Nat. Acad. Sci. Mem. 20:173).

Cynips dugèsi variety **brevipennata** (Gillette)

agamic form

Figures 44, 262, 273, 278

——[no name] Osten Sacken, 1873, Hayden Rpt. U.S. Geol. Surv.: 567, No. 1. Kinsey, 1926, Introd. Biol., fig. 277a.

Holcaspis brevipennata Gillette, 1893, Ent. News 4: 31. Gillette, 1896, Trans. Amer. Ent. Soc. 23: 93, 96. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 42, pl. 9 figs. 4-5. Thompson, 1915, Amer. Ins. Galls: 17, 39.

Disholcaspis brevipennata Dalla Torre and Kieffer, 1910, Das Tierreich 24: 373, 632, 634, 636, 811. Felt, 1918, N.Y. Mus. Bull. 200: 100, fig. 63 (4-5). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 398. Houard, 1928, Marcellia 24: 106.
Andricus pellucidus Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 309, 384, pl. 23 figs. 19-21.
Diplolepis brevipennata Weld, 1922 (not all records), Proc. U.S. Nat. Mus. 61 (18) : 7. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10) : 19.
Cynips dugèsi var. A Kinsey, 1927, Field and Lab. Manual in Biol.: 110.

FEMALE.—Head (including the whole basal half of the antenna), thorax, and legs uniformly rich rufous, abdomen rufous to rufo-piceous; head about as wide as the thorax; parapsidal grooves moderately convergent at the scutellum; foveae large and broad, almost wholly smooth at bottom or limitedly, shallowly sculptured; wings short, about 0.85 of the body in length, extending a little beyond the tip of the abdomen; first abscissa of the radius arcuate-angulate; second abscissa of the radius expanded but not large terminally; radial cell very short and broad, hardly longer than wide; areolet small to closed; the spots in the cubital cell not actually but comparatively large, extending toward the blotch at the base of the cell; length 2.5 to 3.4 mm., smaller than *simulatrix,* distinctly larger than *pupoides.* Figures 273, 278.

GALL.—As described for the species. Apparently not to be distinguished from other varieties of *dugèsi* unless averaging smaller (types up to 15.0 mm. in diameter), with a thinner and more translucent shell. On leaves of the several forms of *Quercus Gambelii* (= *Q. undulata* Gillette, not recent authors), *Q. fendleri* (acc. Weld), and *Q. grisea* (acc. Weld). Figure 262.

RANGE.—Colorado: Manitou (Gillette; *brevipennata* types). Colorado Springs (Carpenter, *pellucidus* types). Trinidad and Morley (acc. Weld 1922). Wetmore, West Cliff, La Veta, and Spanish Peaks (acc. Weld 1926).

New Mexico: Raton, Wagon Mound, Shoemaker, Glorieta, and Tijeras (acc. Weld 1926). Las Vegas Hot Springs (acc. Weld 1922, incl. Kinsey coll.). 28 miles east of Raton (C. Schwachheim in Kinsey coll.).

Probably confined to a limited area in the mountain region of southern Colorado and more northern New Mexico. Figure 44.

TYPES. Of *brevipennata:* 3 females and 20 galls. Holotype and paratype females in the U.S. National Museum; paratype female and galls in the American Museum of Natural History. From Manitou, Colorado; September 30; "*Q. undulata*" (= *Q. Gambelii*) ; C. P. Gillette collector.

Of *pellucidus:* 8 females and 8 galls. Holotype female, paratype female, and galls in the Museum of Comparative Zoölogy; paratype females and galls at the American Museum of Natural History and in the Kinsey collection. One insect bred, the other cut from galls; from

Colorado Springs, Colorado; galls September 25, 1873; Lieut. W. L. Carpenter collector.

Types of both of these were directly compared in making the present re-descriptions.

INQUILINES.—*Synergus similis* Gillette (acc. Gillette 1896).
S. atripes Gillette (acc. Gillette 1896).
S. oneratus (Harris) (acc. Dalla Torre and Kieffer 1910).

Weld found both pupae and adults in galls collected at Manitou as early as October 4 (in 1921), and adults in the galls "ready to emerge" [?] at Wetmore on October 6. Gillette cut live and active females from the galls of the type material on October 31. Weld cut a live adult out of a gall on November 9 (1917); and specimens in the U. S. National Museum (Hopkins coll.) were bred October 31, November 15, November 20 (1918) and January 10. I have seven adults from east of Raton which were bred on November 20 (1927).

I agree with Weld that my *pellucidus* is the same as Gillette's *brevipennata*. The two insects came from probably identical localities, the Garden of the Gods, midway between Manitou and Colorado Springs. A direct comparison of types shows them to agree, even tho *brevipennata* has always figured in the genus *Disholcaspis* where it should never have been placed, while I placed *pellucidus* in the meaningless assemblage called *Andricus* pending the present revision of *Cynips*. My 1920 description of *pellucidus* contained numerous inaccuracies which must give way to the present re-descriptions of the insects.

Considering our present difficulty in separating galls of the species *bella* and *dugèsi*, much less of the several varieties of each species, records for *brevipennata* based on galls alone are of little value.

Cynips dugèsi variety **pupoides,** new variety agamic form

Figures 44, 265, 267, 279

Cynips dugèsi var. B Kinsey, 1927, Field and Lab. Manual in Biol.: 110.

FEMALE.—Head (including the whole basal half of each antenna), the whole thorax, and the legs mostly bright rufous, limitedly darker rufous to rufo-piceous in places; abdomen dark rufous to piceous black; head about as wide as the thorax; parapsidal grooves well separated at the scutellum; foveae rounded, entirely smooth at bottom;

wings short, 0.90 of the body in length, extending little beyond the tip of the abdomen; first abscissa of the radius arcuate-angulate; second abscissa of the radius only slightly expanded terminally; radial cell very short and broad, hardly longer than wide; areolet small; the spots in the cubital cell not actually but comparatively large, extending toward the blotch at the base of the cell; length 2.0 to 2.5 mm., distinctly smaller than either *simulatrix* or *brevipennata*. Figures 265, 267, 279.

GALL.—As described for the species. Apparently not to be distinguished from other varieties of *dugèsi* nor from *Cynips bella congesta* which occurs in the same region. On leaves of *Quercus grisea.*

RANGE.—Texas: Alpine and Fort Davis (Kinsey coll.). Probably confined to the mountain ranges of West Texas (and adjacent New Mexico and Mexico?). Figure 44.

TYPES.—15 females and galls (confused with galls of *Cynips bella congesta*). Holotype female, paratype females, and galls in the Kinsey collection; paratype females at the American Museum of Natural History and the U.S. National Museum. Labelled Alpine, Texas; December 14, 1919; *Q. grisea;* Kinsey collector.

Insects were still emerging from the galls at Alpine, Texas, on December 14 (in 1919), and two days later at Fort Davis; but most of the emergence had occurred before that date.

The two short-winged varieties of *dugèsi,* namely *pupoides* and *brevipennata,* differ in head and thoracic color, in the angle of the parapsidal grooves at the scutellum, and in details of other structural characters. *Pupoides* is distinctly smaller than *brevipennata.* The two insects nearly agree in wing length and in several points of venation; and since they approach each other in their geographic location we may consider that they represent a distinct line of evolution from *dugèsi* and its more typical varieties.

The cynipid fauna of the mountains of West Texas is usually distinct from that of New Mexico and Arizona.

Cynips (Atrusca) bella Bassett

agamic forms

FEMALE.—Head dark rufous, darker to black over much of the face; the antennae rufo-brown, more rufous basally; the thorax not particularly large, rufous to dark rufous, darker to black in places especially anteriorly between the parapsidal grooves, about the lateral lines, at the base of the scutellum, and on the mesopleura; abdomen mostly piceous-black, only limitedly rufo-piceous; legs dark brownish

rufous, brighter basally; anterior parallel lines much smoother than in *dugèsi;* lateral lines broad, smooth, and prominent; scutellum wholly granulose or irregularly shagreened, slightly raised on the mid-line, with a broad, indefinitely bounded foveal groove; hypopygial spine shorter, less slender, and more blunt than in *dugèsi;* the wings long, about 1.35 of the body in length; first abscissa of the radius without a projecting point; the second abscissa with a large, angulated tip; smoky patches in every one of the cells and numerous darker spots in most of the cells, those near the tip of the discoidal cell and those which spread over much of the cubital cell larger, more irregular in shape, tending to coalesce; an irregular, sometimes divided spot in the radial cell toward the curved tip of the radius; length 2.5 to 3.5 mm.

GALL.—Thin-shelled, spherical, sessile leaf gall, with the larval cell held centrally by fine, radiating fibers. Apparently not to be distinguished from the gall of *Cynips dugèsi (q.v.).* Monothalamous. Almost strictly spherical unless distorted by adjacent galls or other pressure; slightly flattened basally where the gall is attached sessily or by

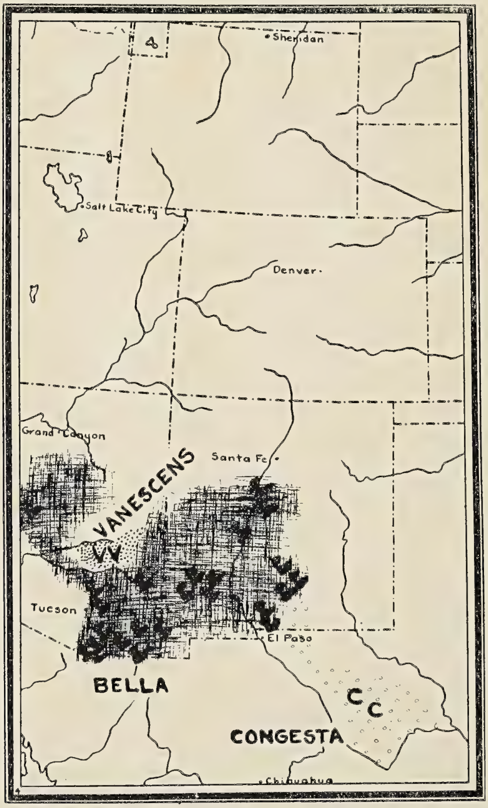


FIG. 45. VARIETIES OF CYNIPS BELLA
Showing geographic isolation of related insects.

a very minute point; up to 28.0 mm., more often between 14.0 and 21.0 mm. in diameter; perfectly smooth, under a lens showing a strictly smooth or a microscopically coriaceous surface or something intermediate; the older galls naked or bearing a very few stellate hairs, the younger galls more clothed in hairs and even finely pubescent, the older galls naked or bearing a very few stellate hairs; the surfaces of older galls dull to shining; the younger galls deep rose; the older galls light yellowish or pinkish brown to rosy pink and occasionally russet or darker, the lighter galls rarely marked or spotted; the shell thin, in some galls twice as thick as in others, sometimes thin enough to be translucent. Internally containing an oval larval cell about 3.0 mm. in length, the cell held centrally by fine, mostly unbranched, not abundant, radiating fibers varying from silky yellow to dark brown in color, these fibers interspersed with an occasional thicker fiber especially between the larval cell and the base of the gall; more abundant, much shorter fibers set on the inside of the shell and on the larval cell. Attached to leaf veins, on the upper or under surfaces, usually on the under surfaces of leaves of practically all of the white oaks of the regions in which the species occurs. Figure 197.

RANGE.—Southern Colorado and western Texas to Arizona, to be expected in Mexico and southward as far as oaks go.

In our Southwest and apparently southward in Mexico there are few cynipid productions more common in the autumn than the oak-apple galls of the several varieties of *Cynips bella* and *Cynips dugèsi.* These are closely related but nevertheless distinct species, each with a number of distinct varieties. The galls of all of these varieties of both species are, however, exactly the same.

The more evident anterior parallel lines, the median ridge on the scutellum, the broad, undivided foveal groove, the shorter hypopygial spine, and the abundant spotting of the wing involving even the basal and radial cells are characters which separate all of the varieties of *bella* from all of the varieties of *dugèsi* and prove the existence of two distinct species here. In each of the oak-inhabited areas of New Mexico and Arizona (and probably Mexico) a variety of each species may be found, growing side by side without interbreeding, at least as far as shown in any of the material I have examined. One of the known varieties of *bella* occurs in southern Arizona and New Mexico, another belongs to the Apache Trail country of Arizona, and a third is in the mountains of West Texas. In each of these, as well as in at least two other faunal areas, *dugèsi* is also represented by a distinct variety.

All of us have been confusing the galls of these several varieties of *bella* and *dugèsi* for some years. Careful examination of many galls of the two shows that some of them are more polished and shining than others, but there are so many of intermediate character that this fails to separate the species. Microscopic examination of the galls shows that some have a coriaceous surface and others have a smooth surface that bears fused irregularities; there are few intergradations in this character, but thus far all the insects which we have definitely connected with galls (both of *bella*, and of the varieties *dugèsi, simulatrix,* and *brevipennata* of the species *dugèsi*) are connected with coriaceous galls. The opaqueness of the galls seems to depend upon a coriaceous surface in conjunction with a thick shell. The coriaceous surface is not necessarily correlated with a thick shell, and there are many grades of thickness and of luster evident in large series.

Considering the many cases in *Cynips* of species and varieties that are almost unrecognizable except on gall characters, it is instructive to find *Cynips dugèsi* and *Cynips bella* producing practically identical galls.

The galls of these two species appear in the early summer. Mature galls with small larvae are obtainable late in August. The adults develop late in October or early in November, and emerge at various dates after that. Most of the adults have emerged by the end of November, but I found some normal emergence occurring at a number of localities in New Mexico late in December (1919) and in Arizona thruout the month of January (1920) under mid-winter conditions in the mountain ranges where the oaks and cynipids occur. Within a few hours after the galls are removed from the trees, their normally pliable outer shells become hard and brittle, and then it seems difficult or impossible for the insects to cut into the concave surfaces with their jaws. This is a big factor in preventing normal emergence after collecting. With few exceptions the hosts of these species are evergreen oaks to the leaves of which most of the galls remain attached over the winter; for part of this time the galls are kept soft by the wet snows of the mountains, but they are often exposed and perhaps dried out enough at many times to delay the normally earlier emergence.

Cynips bella variety **bella** Bassett

agamic form

Figures 45, 263, 272, 280

Cynips bella Bassett, 1881, Canad. Ent. 13: 93. Packard, 1881, U.S. Ent. Comm. Bull. 7: 57. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 198.

Dryophanta bella Mayr, 1881, Gen. gallenbew. Cynip.: 36. Bassett, 1882, Amer. Nat. 16: 246. Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296, 304. Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 369, 371, pl. 12 fig. 4. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 179. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Dalla Torre, 1893, Cat. Hymen. 2: 48. Kieffer, 1901, André Hymén. d'Europe 7 (1): 621. Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 290. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 25. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 343, pl. 12 figs. 1-3. Küster, 1911, Die Gallen der Pflanzen: 170. Thompson, 1915, Amer. Ins. Galls: 17, 37. Felt, 1918, N.Y. Mus. Bull. 200: 100, fig. 97 (1-3).

Andricus bella Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127.

Holcaspis maculipennis Gillette, 1894, Canad. Ent. 26: 236. Cockerell, 1899, Trans. Kans. Acad. Sci. 16: 213. Cockerell, 1900, Southwest (N.M. Normal Univ.) 2: 113. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 54. Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 43 (not pl. 9 figs. 2-3). Thompson, 1915, Amer. Ins. Galls: 17, 39.

Diplolepis bella Dalla Torre and Kieffer, 1910, Das Tierreich 24: 356, 811. Houard, 1928, Marcellia 24: 102, fig. 18-19.

Disholcaspis maculipennis Dalla Torre and Kieffer, 1910, Das Tierreich 24: 375, 811. Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 398.

Cynips maculipennis Felt, 1918 (in part), N.Y. Mus. Bull. 200: 100 [not fig. 63 (2-3)].

Diplolepis bella Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 18.

Dryophanta maculipennis Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: pl. 32 fig. 26.

[NOT *Holcaspis maculipennis* err. det. Beutenmüller, et al. references to Pacific Coast material which is correctly *Cynips mirabilis* Kinsey.]

FEMALE.—Parapsidal grooves moderately separated at the scutellum; foveal groove largely smooth at bottom, but everywhere with a sparse, shallow sculpturing, this sculpturing hardly suggesting a separation into foveae; areolet of moderate size to large; the smoky patches in all the cells of goodly size and number but smaller and less heavy than in *congesta;* the spots in the cubital cell finer, smaller, and fused less often than in *congesta;* the spot in the radial cell of good size; length 2.5 to 3.5 mm., averaging nearer 3.2 mm. Figures 272, 280.

GALL.—As described for the species, apparently indistinguishable from the galls of other varieties of this species and of *Cynips dugèsi.* On *Quercus grisea, Q. undulata, Q. undulata* var. *pungens* (= *Q. wrightii*), *Q. Gambelii, Q. Toumeyi* (acc. Weld), *Q. oblongifolia, Q. arizonica, Q. diversicolor* (acc. Weld; = *Q. reticulata*), and probably related oaks. Figure 263.

RANGE.—New Mexico: Magdalena (*Q. grisea,* Weld incl. Kinsey coll.). Blue Canyon near Socorro, Abo Pass (in Sandia Mts.?), Nogal Canyon, Burro Mountains, Fierro, and Tijeras (galls, acc. Weld 1926). Near Alamogordo at 7000 ft. (*Q. arizonica,* also galls on *Q. undulata,* Kinsey coll.). Highrolls (galls, *Q. undulata,* Kinsey coll.). Mountain Park (galls, *Q. undulata* var., L. H. Bridewell in Kinsey coll.). Hillsboro (*Q. grisea,* Kinsey coll.). Kingston (galls, *Q. grisea* and *Q. Gambelii,* Kinsey coll.). Organ Mountains (R. R. Larkin, *Q. Wrightii; maculipennis* types). Soledad Canyon in Organ Mountains (*Q. arizonica,* L. H. Bridewell in Kinsey coll.).

Arizona: Prescott (*Q. grisea,* Kinsey coll.). Safford, Oracle, Courtland, Fort Huachuca, and Bisbee (galls, *Q. arizonica,* Kinsey coll.). Tucson (= Santa Catalina Mountains? Cox coll., *bella* types). Sabino Trail in Santa Catalina Mountains and Santa Rita Mountains (*Q. oblongifolia, Q. arizonica,* Kinsey coll.). Tumacacori Mountains, Patagonia Mountains, Chiricahua Mountains, Mule Mountains, and Nogales (galls, acc. Weld 1926).

Probably confined to the desert mountain ranges of more southern New Mexico and Arizona (and adjacent Mexico?). Figure 45.

TYPES.—Of *bella:* Holotype female, paratype female, and galls at the Philadelphia Academy; one female at the U.S. National Museum; galls at the American Museum of Natural History. From Tucson (probably the Santa Catalina Mountains), Arizona; host unknown; E. T. Cox collector.

Of *maculipennis:* 1 female and fragments of a gall in the U.S. National Museum. From the west slope of the Organ Mountains, New Mexico; on *Q. Wrightii* (= *Q. grisea* var.); T. D. A. Cockerell collector.

All of the type material of both *bella* and *maculipennis* was examined in making the present re-descriptions.

This is the most widespread variety of the species. The oak-inhabited mountain ranges of this part of the Southwest are isolated by broad deserts, but the available insect material does not show variation enough (unless in the size of the areolet) to warrant a distinction of varieties in this whole area. Weld, however, records galls from Hackberry, Ashfork, and Williams in Arizona, and these more northern localities may represent some other, as yet undescribed variety if the distribution of this insect agrees with that of most of the other Cynipidae of Arizona. The material from the Apache

Trail country of Arizona represents a distinct variety, *vanescens.*

It is surprising to find so many oaks serving as hosts of this one variety, but as far as I can determine they do not effect the isolation of distinct varieties. In this respect *bella* parallels *Cynips dugèsi simulatrix.*

Weld found nearly full-grown galls in southern Arizona (Huachuca Mts.) as early as July 9, and I have fully grown galls dated August 16 and 22. Weld found pupae in galls at Hackberry (representing another variety?) on October 6. He found mature adults emerging from the galls as early as November 1 (1921), and sent me a wasp which was alive for almost three months (until nearly the end of January) after thus coming out of the gall. There were a few live adults left in the galls I collected in New Mexico at Alamogordo on December 21, and at Hillsboro on December 26 (1919), and in Arizona in the Santa Catalina Mts. on January 1 (1920); and these insects emerged soon after collecting. Last winter (1927-28 I had adults emerge from Organ Mountain material on January 2. Weld secured one lot of galls at Tijeras, New Mexico, which were only scantily parasitized, but records only 6 gall makers left in 65 galls collected in the Chiricahuas, and one in fifty in Santa Rita specimens. In my own experience I have never found very high parasitism in this species, tho it might well be expected locally.

I have examined the types of both *bella* and *maculipennis,* and checked them with series representing the wide range and hosts of the present insect. I had already concluded that the two names were *synonyms* when Weld published the same opinion. The types of *bella* and of *maculipennis* were collected at points 270 miles apart but well within the limits of the range of the present insect. The hosts of the types were not the same, but both are represented in our recent collections. As we now understand it, the only insect of the region with which *bella* can be confused is *Cynips dugèsi simulatrix,* but altho the galls of these two are absolutely indistinguishable, the insects are abundantly distinct.

Cynips bella variety **congesta,** new variety
agamic form

Figures 45, 281

FEMALE.—Parapsidal grooves moderately separated at the scutellum; foveal groove largely smooth at bottom but everywhere with a sparse, shallow sculpturing, this sculpturing hardly suggesting a separation into foveae; areolet of moderate size to large; the smoky patches in all the cells of goodly size and number, larger and even heavier than in variety *bella;* the spots in the cubital cell distinctly larger, more often fusing; the spot in the radial cell of good size; length 3.0 to 3.2 mm. Figure 281.

GALL.—As described for the species, apparently indistinguishable from the galls of the other varieties of *bella* or from the gall of *Cynips dugèsi pupoides* which occurs in the same region. On leaves of *Quercus grisea.*

RANGE.—Texas: Alpine and Fort Davis (Kinsey coll.).
Probably confined to the mountain ranges of western Texas (and adjacent regions?). Figure 45.

TYPES.—3 females, many galls (the galls confused with those of *Cynips dugèsi pupoides*), in the Kinsey collection. Labelled Alpine, Texas; December 14, 1919; *Q. grisea;* Kinsey collector.

These insects were emerging on December 14 (in 1919) at Alpine, Texas, and two days later at Fort Davis, Texas. *Cynips dugèsi pupoides,* whose galls also occur at Alpine and Fort Davis, is a small, short-winged insect that cannot be confused with *congesta.*

Cynips bella variety **vanescens,** new variety
agamic form

Figures 45, 282

FEMALE.—Parapsidal grooves rather closely convergent at the scutellum; entire foveal groove finely rugose at bottom, without a trace of separation into foveae; areolet of moderate size; spots in the cubital cell reduced in number and size, not dark; the markings in the radial cell quite small; length 2.5 mm. Figure 282.

GALL.—As described for the species, apparently indistinguishable from the galls of the other varieties of *bella* and probably from an as yet undescribed variety of *dugèsi* that may occur in the same region. On leaves of *Quercus grisea.*

RANGE.—Arizona: Globe (Kinsey coll.). Apache Trail at Fish Creek (galls, Kinsey coll.).

Probably restricted to a limited area that lies east of Phoenix in Arizona. Figure 45.

TYPES.—1 female and galls (the galls possibly confused with material of some variety of *dugèsi*); in the Kinsey collection. Labelled Globe, Arizona; January 20, 1920; *Q. grisea;* Kinsey collector.

Most of the insects of this variety had emerged at Globe, Arizona, before January 20 (in 1920), but the type female emerged after that.

It is never good practice to publish a new species on the basis of a lone specimen, but it is perhaps permissible when the new form is clearly differentiated from a group of related things whose variation, range, and host relations we already understand.

Cynips (Atrusca) cava (Weld)
agamic form

Figures 46, 260-261, 270, 283

Diplolepis cava Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 22, fig. 5.

FEMALE.—The head entirely rich rufous, or rarely blackish on the face medianly; the antennae rufo-brown, more rufous on the first two segments; the thorax of moderate size, rich, bright rufous, darker brownish rufous in places; anterior parallel lines rather broad; lateral lines rather broad, not long; scutellum rich, bright rufous, moderately rugose, flattened or even slightly depressed along a median line, with two more or less defined foveae which are largely smooth and only shallowly sculptured; pronotum rich, bright rufous; the abdomen mostly dark rufous, lighter rufous antero-laterally and on the hypopygium; the hypopygial spine of moderate weight; legs including the coxae wholly rich, bright rufous; wings not quite full length, about 1.15 of the body in length; the first abscissa of the radius without a projecting point; the second abscissa with a moderately swollen tip; areolet moderately large; an indefinite, very light, smoky patch near the base of the cubital cell and a very few, indefinite, light colored spots nearer the tip of the same cell; the radial and discoidal cells unspotted; a slight infuscation at the break in the discoideus; length 2.7 to 3.9 mm., averaging nearer 3.4 mm. Figures 270, 283.

GALL.—A large, gourd-shaped leaf gall with a spherical body, with fine, dense fibers supporting the central larval cell. Monothalamous. Most of the gall strictly spherical, up to 22.0 mm. in diameter, drawn out into a short, rather stout, more or less cylindrical base which may be as much as 3.0 mm. in length and 3.0 mm. in diameter; the surface essentially smooth but not very shining, microscopically

shagreened; young galls light yellow with a rose tinge; older galls becoming light russet brown, unspotted; the outer shell rather thin but hard and brittle when dry. Internally filled with silky, moderately dense (but not packed), branching fibers which hold the larval cell centrally; some short, incomplete fibers also on the inner wall of the outer shell and on the larval cell; the cell up to 3.5 mm. in diameter. Attached by a fine point at the bottom of the drawn-out base; on the upper or (more often) the under surfaces of leaves of *Quercus breviloba* and its form *laceyi*. Figures 260-261.

FIG. 46. CYNIPS CAVA
Possible extension of known range shown by shading.

RANGE.—Texas: Austin (type, Weld coll.; also Patterson in Kinsey coll.). Round Rock and Leander (Kinsey coll.). Boerne and Kerrville (acc. Weld 1926).

Probably restricted to a limited area in Texas, extending mostly west from Austin. Figure 46.

TYPES.—Holotype and 2 paratype females and galls at the U.S. National Museum, Cat. No. 27189. Paratype females in the American Museum of Natural History, the Field Museum, Stanford University, and the Kinsey collection. From near Austin, Texas; galls October, 1917; *Q. breviloba;* Weld collector.

The present re-descriptions are made from all the types in the American, Field, and National Museums and in the Kinsey collection, as well as from a large series I have from near the type locality.

This gall closely resembles the galls of the related species *bella* and *dugèsi*, but differs in having a drawn-out, blunt base. Patterson found young galls as early as June 7 (in 1921).

The galls develop thru the summer and fall, the adults maturing and chewing out of the larval cells sometime before emergence from the outer walls of the galls. On November 10 and 20 Weld found pupae which transformed on November 26 and later. He found adults among the radiating fibers in the galls by December 4. Patterson found live adults in this condition on November 25 (in 1921). By early December most of the galls have fallen from the trees, in many cases still attached to the dead leaves, and some of the adults begin emerging then, altho my collections made on December 6 and 8 (in 1919) still contained many adults which did not emerge until later.

Several of the cynipid species which occur just northwest of Austin are confined to the Texan post oak, *Quercus breviloba,* and it is possible that we will not find *cava* on any other host.

The insect is close to *Cynips bella* and *dugèsi. Cava* might be considered a variety of *dugèsi,* but its median depression on the scutellum, its nearly unspotted wings, and more particularly its distinctive gall leads to my conclusion that it is a distinct species. *Cynips cava* and *Cynips dugèsi* are the only insects in this genus which have shortened wings in which the reduction is less than forty per cent of the wing length normal for the subgenus.

Cynips (Atrusca) centricola Osten Sacken agamic forms

FEMALE.—The head dark rufous to black, the antennae dark rufous to black, sometimes entirely rufous basally; the thorax rather large and heavy, entirely blackish in some varieties, with some dark rufous; anterior parallel lines rather prominent, of moderate width; lateral lines broad, prominent, long but in part finely shagreened; median groove absent to well developed; scutellum rather irregularly rugose, a bit flattened along a median line, with large, broad, not deep, indefinite foveae which are weakly sculptured and minutely roughened and only poorly separated; abdomen dark rufo-piceous, more rufous toward and on the hypopygium; the hypopygial spine of moderate weight; legs bright to dark rufous and black, the tarsal claws of moderate weight, distinctly toothed; wings long, about 1.35 of the body in length; the first abscissa of the radius with a short, projecting, infuscated point; the second abscissa curved mostly toward the tip, with or without a triangulate tip; radial cell moderately long, of moderate

width; a small, very indefinite clouding at the base of the cubitus, a larger, more definite patch at the base of the cubital cell, and a few, darker brown, very irregular, fused spots in the cubital cell; discoidal cell clear; length 3.0 to 4.5 mm.

GALL.—A large, spherical, spotted or unspotted, thin-shelled leaf gall with rather sparse, radiating fibers. Monothalamous. Strictly spherical except where flattened a bit at the point of attachment; ivory to apricot or more pinkish in color, some galls well covered with purplish spots; smooth and often shining, only very microscopically roughened, young galls with a microscopic, stellate pubescence; up to 26.0 mm., averaging under 20.0 mm. in diameter. Internally hollow except for the thick-walled larval cell which is up to 4.0 mm. in length, for the relatively few, silky, radiating, branched fibers that hold the larval cell in position, and for a few shorter, incomplete, branched fibers also located on the inner wall and on the larval cell. Attached by a minute point to a vein; usually on the under surface of a leaf, on *Quercus stellata*. Figure 197.

RANGE.—Known from New York to Florida, Missouri, and Texas; probably not extending much further than this. Figures 47, 48.

This is the oldest and most commonly known American species of *Cynips*, but it is poorly represented in most collections. None of the published data, nor most of the collections I have made would indicate that it is ever abundant in any part of its range, but I have on several occasions found individual trees bearing more than fifty galls each. These galls are confined to the post oak, *Quercus stellata*, on the leaves of which they are strikingly beautiful objects. There are four known varieties, *centricola* from the Coastal Plain and its inland extensions, *clivorum* from the Southern Appalachians, *strians* from the Ozark area, and Karsch's *rubrae* from Texas. The varieties are separable on only a few insect characters, and on the presence or absence of spots on the galls, and altho typical material from the center of each range is definitely determinable, hybrid material from areas between two of these ranges is not easily analyzed. The slow evolution in this species is in contrast to the more rapid evolution of such a species as *Cynips mellea* in the same range.

The presence or absence of spots on the galls of this species was taken by Osten Sacken, in the original description of the typical variety, to vary with the age of the gall. It is possible that the amount of weathering has something to do with this, but I have unspotted galls of the normally unspotted variety *clivorum* collected on various date from October 24 to Novem-

ber 16, and spotted galls of the normally spotted varieties *rubrae* and *strians* from September 9 to January 21. Only with variety *centricola* do we regularly find galls of both types, and the data do not seem to show whether hereditary or environmental factors are concerned in this instance.

The galls of *centricola* superficially resemble those of *Amphibolips inanis,* a black-oak species of the eastern United States; but *inanis* galls are distinguishable by their host and by their fewer, coarser fibers, and by numerous other points. The galls of *centricola* even more closely resemble those of the Pacific Coast species, *Cynips mirabilis,* but the galls of *mirabilis* have denser fibers inside. *Mirabilis* and *centricola* belong to distinct subgenera. Some of the unspotted galls of *Cynips centricola clivorum* also approach near identity with the galls of *Cynips bella* and *Cynips dugèsi.*

Centricola is in several respects distinct from the other species of the subgenus *Atrusca,* but these differences are not fundamental enough to warrant the establishment of another subgenus for one species.

Cynips centricola variety **centricola** Osten Sacken

agamic form

Figures 47, 271, 284

Cynips quercus centricola Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 53, 58. Cresson, 1862, Proc. Ent. Soc. Phila. 1: 202.

Cynips q. centricola Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 246, 247. Riley, 1871, Canad. Ent. 3: 195.

Cynips centricola Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 339, 345, 347, 350, 375. Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.

Loxaulis centricola Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296.

Holcaspis centricola Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 304. Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127, 202. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 179. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Dalla Torre, 1893, Cat. Hymen. 2: 55. Comstock, 1895, Manual Ins.: 619. Dalla Torre, 1898, Cat. Hymen. 5: 7. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Kellogg, 1904, Amer. Ins.: 471. Felt, 1906, Ins. Aff. Pk. & Woodl. Trees 2: 711. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 42, pl. 9 fig. 1. Beutenmüller in Smith, 1910, Ins. N. J.: 600. Thompson, 1915, Amer. Ins. Galls: 17, 39.

Dryophanta centricola Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 290. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 82. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30:352. Felt, 1918, N.Y.

Mus. Bull. 200: 98, fig. 63 (1). Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: pl. 32, fig. 27.

Holcaspis centricula Beutenmüller in Smith, 1910, Ins. N.J.: 597.

Diplolepis quercus-centricola Dalla Torre and Kieffer, 1910, Das Tierreich 24: 369, 637, 811.

Disholcaspis centricola Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 398.

Diplolepis centricola Comstock, 1924, Introd. Ent.: 926. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 23. Weld in Leonard, 1928, Ins. N.Y.: 969.

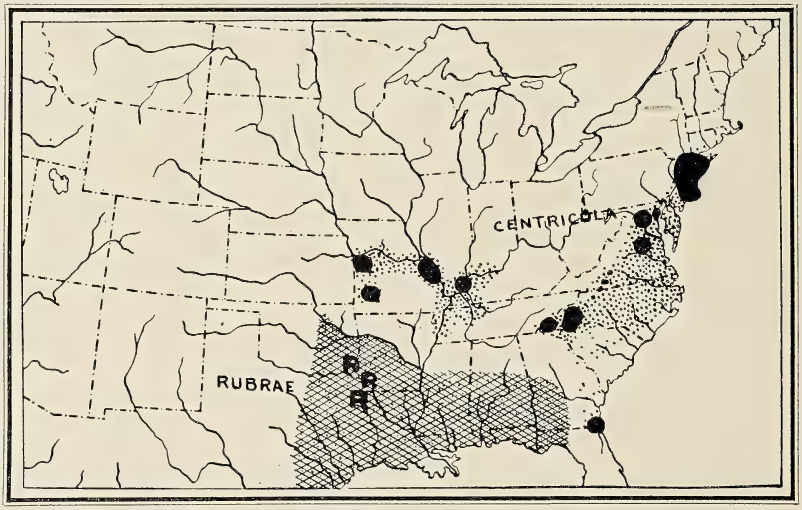


FIG. 47. TWO VARIETIES OF CYNIPS CENTRICOLA

Coastal Plain varieties possibly derived from more widespread, ancestral stock migrating out of Southwest.

[NOT *Holcaspis centricola* err. det. M. T. Cook papers and resulting Indiana records, which are correctly *Andricus singularis* (Bassett).]

FEMALE.—Head and thorax often with some rufous, sometimes largely bright rufous, the antennae with some rufo-piceous on the basal segments, sometimes with the basal segments wholly rufous; median groove only poorly indicated; the tip of the second abscissa of the radius distinctly and broadly triangulate; the marks at the apex of the cubital cell not abundant but often fused into chains. Figures 271, 284.

GALL.—Usually well covered with rich red purple spots, occasionally unspotted; on leaves of *Quercus stellata*.

RANGE.—New York: New York City (Angus in Amer. Mus. and Kinsey coll.). Farmingdale (W. T. Davis in Kinsey coll.).

New Jersey: Fort Lee and New Brunswick (acc. Beutenmüller in Smith 1910: 597). Lakehurst (Beutenmüller in Amer. Mus. and Kin-

sey coll.). Toms River (W. T. Davis acc. Beutenmüller in Smith 1910: 600).

D.C.: Washington (types, Osten Sacken coll.).

Virginia: Golansville (Kinsey coll.).

North Carolina: Asheville (Ashmead in Phila. Acad. and U.S. Nat. Mus.). Murphy (Kinsey coll.). Hendersonville (incl. hybrids with *clivorum;* Kinsey coll.).

Florida: eastern part (Ashmead in Phila. Acad.).

Illinois: Eddyville (hybrid with *strians;* O. Buchanan in Kinsey coll.).

Missouri: Barnhart (E. S. Anderson in Kinsey coll.). Rush Tower (gall, E. S. Anderson in Kinsey coll.). Grain Valley (gall, R. Voris in Kinsey coll.). Springfield (R. Voris in Kinsey coll.).

Probably restricted to the Atlantic Coastal Plain, the area on the east side of the Appalachians, and the inland extensions of the Coastal Plain in the Mississippi Valley. Figure 47.

TYPES.—Female and gall at the Museum of Comparative Zoöl-ogy. From Washington, D.C.; October; "*Quercus obtusiloba*" (= *Q. stellata*); Osten Sacken collector.

The present re-descriptions are made from New York, Washington, D.C., and Virginia material, part of it compared some years ago with the type material.

INQUILINES.—*Synergus laeviventris* (Osten Sacken) (acc. Osten Sacken 1865).

Gelechia geminella Linnaeus (acc. Riley 1871). A European moth; doubtful determination.

PARASITE.—*Baryscapus centricolae* Ashmead (acc. Ashmead 1887).

This variety of the species is well known from the eastern Coastal Plain, and we are now including data on its occurrence inland on the remants of the Coastal Plain in Illinois and Missouri. The British Columbia record for *centricola* in the Dalla Torre and Kieffer publications is, as usual, a misinterpretation of Osten Sacken's record of "D. C."

The galls of *centricola* are obtainable as early as August 20 (1927, at Eddyville, Illinois). They are full grown before the end of September, and mature adults may sometimes be found in them early in October. By the middle of October most of the galls have fallen to the ground where they quickly disappear under the dead leaves that accumulate under the trees. Weld records unemerged adults in the galls at Washington on October 9 and 20 and November 1. These adults, in common with other species of *Cynips,* do not emerge immediately. Weld secured emergence on November 17, 26, and December 8.

I have bred adults from Virginia material on December 5 (1928), and this is probably an average date for the appearance of the insects.

Osten Sacken's original description does not accurately describe the surface of the insect, probably because of the lower magnifications he employed. The types, from Washington, agree with the New York specimens. Beutenmüller's statement that the parapsidal grooves closely converge at the scutellum does not agree with the American Museum specimens I have examined, altho these were probably the insects on which that author's descriptions were based.

Cynips centricola variety **clivorum,** new variety agamic form

Figures 48, 258-259, 269, 285

FEMALE.—Head, entire antenna and thorax usually entirely black; median groove poorly indicated or absent; the tip of the second abscissa of the radius enlarged but not triangulate; the marks in the cubital cell usually much fused. Figures 269, 285.

GALL.—Always unspotted; on leaves of *Quercus stellata.* Figures 258-259.

RANGE.—Ohio: Coolville (types, Kinsey coll.). Chillicothe (Kinsey coll.).
West Virginia: Parkersburg (Kinsey coll.).

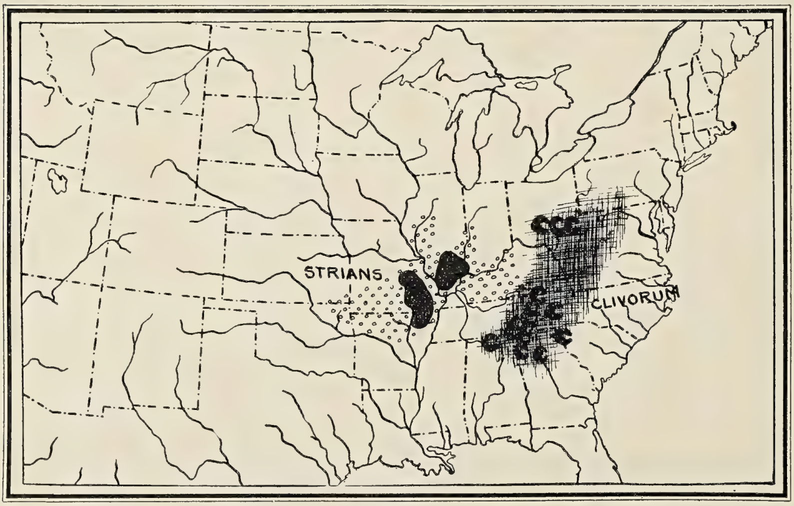


FIG. 48. OZARK AND APPALACHIAN VARIETIES, C. CENTRICOLA
Possible extensions of known ranges shown by shading.

Tennessee: Tazewell, Clinch River near Maynardsville, and Charleston (galls, Kinsey coll.). Tellicoe River near Madisonville, and 9 miles northeast of Chattanooga (incl. some hybrids with *centricola;* Kinsey coll.).

North Carolina: Hendersonville (incl. some hybrids with *centricola;* Kinsey coll.).

South Carolina: Travellers Rest (Kinsey coll.).

Georgia: 6 miles north of Trion, and Rome (Kinsey coll.). Acworth (gall, Kinsey coll.).

Alabama: Athens (gall, Kinsey coll.).

Probably confined to a limited area on the western side of the Southern Appalachians. Figure 48.

Types.—20 females and many galls in the Kinsey collection. From Coolville, Ohio; galls October 24, 1928; insects November 13 and December 1, 9, 16, and 20, 1928; *Q. stellata;* Kinsey collector.

Thruout the more southern portion of the Appalachians, from the foothills in southern Ohio and southward into Georgia and Alabama, this is the variety of *centricola* to be expected wherever *Quercus stellata* occurs. This part of the country is poorly known biologically, and much of its cynipid fauna has not been previously described. At lower levels both east and west of the Great Smokies *clivorum* appears to hybridize with variety *centricola,* and such hybridization may be expected wherever the two come into contact. *Clivorum* is to be distinguished by the insect characters noted in the comparative descriptions, and also by the unspotted gall. The gall of variety *centricola* is also unspotted on occasion, especially when immature, but *centricola* is usually well covered with bright purplish spots.

My insects of this variety were bred on November 2 and 13, December 1, 9, 15, 16, 18, and 20, and January 2 (all in 1928). Even tho winter comes early in much of the range of this variety, emergence is at just about the same dates as the emergence of varieties *centricola* and *strians,* both of which occur in warmer areas.

Cynips centricola variety **rubrae** (Karsch)
agamic form

Figures 47, 274, 275

Diplolepis quercus-rubrae Karsch, 1880, Zeitschr. gesammt Naturw. 5: 293, pl. 6 figs. 4a, b. Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 369. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 344, 355, 811.

Cynips rubrae Dalla Torre, 1893, Cat. Hymen. 2: 76.

Dryophanta rubrae Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 351, pl. 13 figs. 4-5. Felt, 1918, N.Y. Mus. Bull. 200: 98, fig. 99 (4-5).

Diplolepis centricola err. det. Weld, 1926 (in small part), Proc. U.S. Nat. Mus. 68 (10) : 23.

FEMALE.—Not available for comparison. See the original description below. Figure 275.

GALL.—Well marked with purplish spots; on *Quercus stellata*. Figure 274.

RANGE.—Texas: (types, probably from Texas, Van Zandt coll.). Marshall (gall, W. A. Lansford in Kinsey coll.).

Oklahoma: Tuskahoma (galls, acc. Weld 1926).

Arkansas: Texarkana (galls, acc. Weld 1926).

Probably confined to an area extending from eastern Texas into southern Oklahoma, Arkansas, and Louisiana, and possibly eastward along the Gulf. Figure 47.

ORIGINAL DESCRIPTION.—Karsch, 1880, Zeitschr. gesammt. Naturw. 5: 293, pl. 6 figs. 4, 4a, 4b.

4. *Diplolepis quercus-rubrae,* n.sp. Fig. 4, 4a, 4b.

Das Cecidium ist fast kugelrund bei einem Durchmesser von im Mittel 2 cm. An der Ansatzstelle (des Blattes?) zeigt es eine kleine nabelartige Vertiefung und ist auf der ganzen Ansatzfläche schwach abgeflacht. Die Peripherie bildet eine dünne, undurchsichtige, auf der freien Halbkugel gelbfarbige und mit unregelmässig vertheilten, rothbraunen Sprenkelflecken getigerte Schale, während die genabelte Halbkugel schön weisslich und ungefleckt erscheint. Im Innern hohl birgt die Kugel eine kleine unregelmässig gestaltete Innengalle, welche durch radiäre, von verschiedenen Punkten unregelmässig nach der innern Schalenperipherie ausstrahlende fadenförmige, sehr zarte, gelbweisse Fortzsätze in ihrer festen Lage im Centrum erhalten wird. Auch von diesem schönen Cecidium liegen im Berliner Museum 2 übereinstimmende Exemplare vor, die bereits das Flugloch der Wespe zeigen, also ausgewachsen sind, aber in ihrer Grösse gleichwohl ein wenig differiren, indem das grössere eine Höhe von 2, einen Breitendurchmesser von 2, 3cm hat. Der Signatur zufolge stammen sie "aus van Zandt von Quercus rubra"L. Da jede weitere Angabe fehlt und nur die Gallen mit ihren Cecidozoën sich vorfinden, so lässt sich über die Insertionsstelle am Baume nichts mit Gewissheit sagen; doch möchte aus der Aehnlichkeit der Cecidien mit unserem *Diplolepis longiventris* (Hrtg.) im Allgemeinen der Schluss, dass sie ebenfalls als Blattgallen entstehen, nicht ungerechtfertigt sein.

Das in 2 übereinstimmenden Exemplaren vorliegende Cecidozoon zeigt im wesentlichen die Charaktere von *Dryophanta.* Es ist 4mm lang, seine Breite mit Flügelspannung beträgt 1,1cm. Die Antennen sind 14-gliedrig, an der Spitze nicht verdickt; die Leibesfarbe, die Fühler und Beine braun, der Leib kurz aber dicht behaart, die Behaar-

ung heller bräunlich-gelb; das bucklig abgerundete Schildchen neigt nach hinten über, ist dicht und lang behaart, namentlich an der Spitze. Mit der Lupe erkennt man deutlich die Furchen der Parapsiden und die Grübchen an der Basis des Schildchens. Die lang vorgezogene Spitze des ersten Hinterleibssegmentes ist mit stärkeren braunen Borsten besetzt. Die gelbbräunliche, wenngleich schwache Behaarung giebt dem Thiere trotz der dunkelbraunen Grundfarbe ein helleres Ansehen. Die Flügel endlich sind äusserst charakteristisch: seine Areola ist nicht völlig geschlossen, die äussere Cubitalzelle zeigt nahe dem Flügelrande eine zickzackförmige Zeichnung von derselben dunkelbraunen Farbe wie die Adern des Flügels. Auch ist im Gegensatze zu No. 1 und 2 die innere Cubitalzelle in der hinteren Innenecke offen.

Translation.—Diplolepis quercus-rubrae new species. The gall is nearly spherical with a diameter of 20.0 mm. At the point of attachment (to the leaf?) there is a small depression resembling a navel and the entire base of the gall is rather flattened. The wall of the gall consists of a thin, opaque shell, the upper half of which is yellowish and marked with irregularly distributed, reddish brown splotches or spots, while the lower half is beautifully whitish and unmarked. In the hollow interior there is a small, irregularly shaped larval cell, which is solidly held in place in the center of the gall by radiating and very delicate, yellowish white fibers which extend from numerous, irregularly developed points to the inner surface of the outer wall of the gall. In the Berlin Museum there are exhibited two nearly identical specimens of this pretty gall showing the emergence holes of the insect, these galls consequently fully developed but differing somewhat in their size, for the larger has a height of 20.0 mm. and a horizontal diameter of 23.0 mm. The label of this specimen reads "from Van Zandt, from *Quercus rubra* Linnaeus." Further data are lacking, and only the gall and its producer are there, so it is impossible to state precisely where the gall is attached to the tree; but because of the similarity of the gall to our *Diplolepis longiventris* it seems not unwarranted to conclude that this is also a leaf gall.

In the examples available, the insect shows principally *Dryophanta* characters. It is 4.0 mm. long, with a wing expanse of 11.0 mm. The antennae are 14-segmented and are not enlarged terminally; the body, antennae, and legs are brown, the body [thorax] is densely set with short hairs, the hairs bright brownish yellow; the hump-backed, rounded scutellum projects posteriorly and it is densely hairy with long hairs, particularly at the tip. With a lens one may readily discover the parapsidal grooves and the foveae at the base of the scutellum. The elongated tip [hypopygial spine?] of the posterior segment of the abdomen is set with rather stiff brown hairs. The golden brown hairs, even tho not abundant, give the animal a brilliant aspect in spite of its dark brown ground color. Finally, the wings are very characteristic: the areolet is not small, the third cubital cell has, near the anterior margin of the wing, a zigzag marking of the same dark brown color as the veins of the wing. On the other hand the first cubital and discoidal cells are open at base [*i.e.* the cubitus does not extend to the basalis].

TYPES.—Two females and two galls in the Berlin Museum. From North America (without definite locality), probably from Texas; credited to *Quercus rubra* (certainly by mistake); Van Zandt collector.

The present re-descriptions are based on the original figure and description, and on gall material I have from Texas.

In 1880 Karsch described *Diplolepis rubrae*. His material came from Van Zandt, without definite locality, but it may be presumed to have come from Texas where the same collector had obtained other material. The insect was labelled as from "red oak", which of course is an impossible host for any species of true *Cynips*. The types of Karsch's *rubrae* are in the Berlin Museum, and no American student of Cynipidae has examined them. Fortunately the published description was accompanied by drawings of the gall and of wings of the insect, and both are reproduced in the present paper.

I know of no galls in the United States which agree with the description and figure of *rubrae* except *Cynips centricola, Amphibolips inanis* and *Cynips mirabilis*. Neither *inanis* nor *mirabilis* have wings of the sort figured for *rubrae*. On the other hand, I can see nothing in Karsch's drawings or descriptions which would rule out *centricola*, and the cubital cell markings in the figure are peculiar to *centricola*. I have no doubt that *rubrae* represents some variety of *centricola*.

That our present species occurs in Texas, where the *rubrae* types are presumed to have originated, is verified by gall material which I have (without insects) from Marshall, in the northeastern corner of that state; and Weld has galls from localities just north of that state in Arkansas and Oklahoma. Judging from the ranges of other Cynipidae, the Texan variety should not occur north of central Arkansas or east of western Florida. However we must await insect material from that area and an examination of the Berlin types before we can make critical comparisons.

Cynips centricola variety **strians**, new variety agamic form

Figures 48, 256-257, 286

Diplolepis centricola err. det. Weld (in large part), 1926, Proc. U.S. Nat. Mus. 68 (10): 23.

FEMALE.—Largely black but often with a rufous tinge on the thorax and even more rufous on the head; median groove almost always

well evident for half the length of the mesonotum, deeply cut posteriorly; the tip of the second abscissa of the radius slightly triangulate but not broadly so as in variety *centricola;* the marks in the cubital cell not abundant nor large. Figure 286.

GALL.—Almost always well spotted with brownish purple; on leaves of *Quercus stellata.* Figures 256-257.

RANGE.—Illinois: Bonnie (types, Kinsey coll.). Christopher, Norris City, and Bloomfield in Johnson County (Kinsey coll.). Eddyville (hybrid with *centricola;* O. Buchanan in Kinsey coll.).

Missouri: Annapolis (E. S. Anderson in Kinsey coll.). Arcadia (gall, Kinsey coll.). Ironton and Poplar Bluff (acc. Weld 1926).

Arkansas: Hoxie (gall, acc. Weld 1926).

Probably restricted to the Ozark areas in Arkansas and Missouri, and to the eastward expansions of that area in Illinois and possibly western Kentucky and southern Indiana. Figure 48.

TYPES.—11 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum and the U.S. National Museum. Labelled Bonnie, Illinois; gall October 15, 1927; *Q. stellata;* Kinsey collector.

This is the Ozark variety of the species, known from the true Ozarks of Arkansas and Missouri, but like so many other Ozark Cynipidae it is common in the hill country of Illinois, and to be expected in western Kentucky and the southwestern part of Indiana which is geologically related to the Ozarks. This region is bisected by the Mississippi and lower Ohio Valleys, in both of which we have found the Coastal Plain variety *centricola,* and since both *centricola* and *strians* have similarly spotted galls, determinations of material from this region must depend on the insect characters given in the comparative descriptions. *Strians* is the only variety of the species which shows a well developed median groove.

Weld found pupae in galls probably representing this variety on October 10. I have bred adults on December 10 and 20 (1927).

Cynips subgenus **Acraspis** Mayr
bisexual and agamic forms

Acraspis Mayr, 1881, Gen. gallenbew. Cynip.: 2, 29. Dalla Torre, 1893 (in part), Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1910 (in part), Das Tierreich 24: 408. Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 359. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 13. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 57-58. Also of numerous other authors.

Dryophanta Mayr, 1881 (in part), Gen. gallenbew. Cynip.: 35. Beutenmüller, 1911 (in part), Bull. Amer. Mus. Nat. Hist. 30: 343. Also of assignments of long-winged and bisexual forms by numerous other authors.

Sphaeroteras Ashmead, 1897, Psyche 8: 67. Maintained by few other authors.

Acraspis united with *Philonix* in Ashmead, 1903, Psyche 10: 148. Also in Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 246.

Cynips of some of the assignments of several, especially older authors.

Diplolepis Dalla Torre and Kieffer, 1910 (in part), Das Tierreich 24: 342. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 14-34. Also of assignments of long-winged and bisexual forms by some other authors.

Biorhiza of some assignments of short-winged forms by various authors.

Andricus of one assignment of each: Osten Sacken, Ashmead, Kinsey.

Trichoteras of one assignment (Dalla Torre and Kieffer, 1910, Das Tierreich 24: 404).

Xystoteras of one assignment (Britton, 1920, Checklist Ins. Conn.: 319).

FEMALE.—The cheeks more or less enlarged behind the eyes (agamic forms), or hardly enlarged (bisexual forms); antennae of moderate length with (rarely) 13 or (usually) 14 or even 15 segments in some varieties; the thorax of moderate size (in long-winged varieties) or much reduced (in short-winged varieties); the parapsidal grooves usually continuous but in many cases (especially short-winged varieties) poorly defined or even lacking anteriorly; anterior parallel lines poorly defined or lacking; median groove absent or shallowly indicated posteriorly; mesopleura (agamic forms) in part smooth and shining, with a sparse to heavy punctation, more or less hairy; or mesopleura (bisexual forms) more nearly smooth and naked; abdomen entirely smooth and naked except for the hairs latero-basally, or (in two varieties of *nubila* and in many short-winged varieties) hairy on all of the segments laterally; hypopygial spine moderately broad, drawn out at the ventral tip (in long-winged and some short-winged forms); or hypopygial spine of uniform width for nearly the whole length and bluntly rounded at the tip (in most short-winged forms); tarsal claws of moderate weight, toothed or (in *mellea*) merely broadened basally and nearly simple in some varieties; wings long, about 1.30 times the body length, or half that length, or as short as 0.14 of the body in

length; if the wings are long, the second abscissa of the radius (agamic forms) is somewhat curved, with an indication of a slight angle one-third to two-thirds of the way from the base, the vein usually ending in an angulated expansion; the second abscissa in bisexual forms is more nearly straight; the radial cell is only moderately long and quite broad (agamic forms), or a little longer and more narrow (bisexual forms); the radial cell is always clear of spots; the areolet is very small to very large; the cubital cell is entirely clear or (more often) with large, smoky patches (not spots); the discoidal cell is always clear; moderately stout to slender insects, 1.2 to 3.5 mm., agamic forms averaging nearer 2.7 mm., and bisexual forms nearer 2.0 mm. in length.

MALE.—Differing from the bisexual female as described for the genus.

GALL OF AGAMIC FORMS.—Usually spherical; cone-shaped in one species *(conica)*; moderate-sized galls; smooth and naked or minutely pubescent or coarsely faceted or closely set with slender, flexuous spines which in one species *(nubila)* form a dense, woolly, or hair-like coating that completely covers the central core; the galls thick-walled, loosely crystalline or compact; usually with a large central cavity occupying most of the gall; in one species *(pezomachoides)* with from 1 to 8 larval cavities side by side, the gall consequently more ellipsoid than spherical; in every case without a distinct larval cell. Attached singly or (more often) to the under surfaces of the leaves of white oaks of all the groups found in the range of the subgenus.

GALL OF BISEXUAL FORMS.—As far as known: Small, thin-walled, elongate egg-shaped; monothalamous, rarely two or three fused

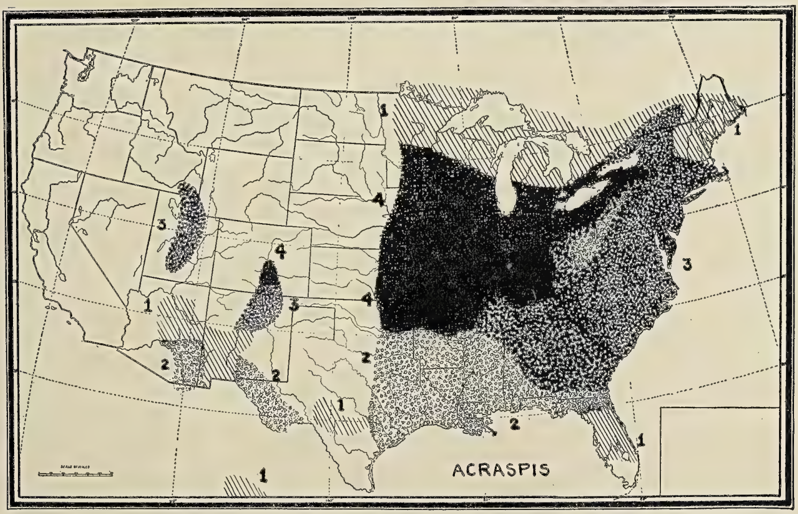


FIG. 49. KNOWN RANGE, SUBGENUS ACRASPIS
Shading and figures indicate number of species known from each area.

together; without a distinct larval cell; the gall more or less hidden in an otherwise more or less unmodified bud; on the species of oak on which the corresponding agamic form occurs.

RANGE.—Probably wherever white oaks occur from the northeastern United States, southern Canada, and the more northern Rocky Mountains to Florida, Texas, and Arizona, southward into Mexico. Known from five species which extend east of the Mississippi Valley and (four species) to the Atlantic Coast, and from three species confined to the Southwest and Mexico. The present center of distribution nevertheless in the Southwest. Figure 49.

SUBGENOTYPE.—Of *Acraspis: Cynips pezomachoides* Osten Sacken = *Cynips (Acraspis) pezomachoides pezomachoides.* One of the two species originally included in Mayr's description of *Acraspis.* Designated by Rohwer and Fagan, 1917, Proc. U.S. Nat. Mus. 53: 359.

Of *Sphaeroteras: Biorhiza mellea* Ashmead = *Cynips (Acraspis) mellea mellea.* Ashmead's genus *Sphaeroteras* was monobasic and established for *mellea.*

As here interpreted, this is a southwestern and more eastern American subgenus, and the best known of the American groups of *Cynips.* Of the seven species of the whole genus *Cynips* represented east of the Mississippi River, five *(pezomachoides, hirta, gemmula, villosa,* and *mellea)* belong to the present subgenus. All of these five are, however, to be expected in the southern Rocky Mountains, and one of these *(villosa)* is known from New Mexico and Arizona. The other three species of the subgenus *(conica, arida,* and *nubila)* are not known outside of our Southwest and Mexico. We may expect undescribed varieties of *Acraspis* to repay some future explorer in the mountain regions of Mexico.

Acraspis is known from 8 species representing a total of 42 varieties, for 2 of which both the agamic and bisexual forms are described. The typical varieties of the five more eastern species were all described before 1888. It is doubtful if additional species of *Acraspis* remain to be discovered in this part of the country, altho it is certain that numerous varieties of these species are not yet described. One of the southwestern species was described in 1881, and two are added in the present paper. The range of one of the more eastern species *(villosa)* was extended into the Southwest only last year. Thus there is no indication of the exhaustion of either the new varieties or species of *Acraspis* in that part of the country.

But if the eastern species have long been known, their generic relations have been most variously interpreted. This has been because some of the varieties are long-winged insects while others are short-winged insects with consequently modified thoracic and abdominal characters and strangely transformed hypopygial spines. Eight of the short-winged agamic forms have been assigned to *Acraspis* (or included under *Philonix*), one of the short-winged forms was the basis of the generic name *Sphaeroteras,* the single long-winged eastern variety was with some doubt assigned to *Dryophanta* (or *"Diplolepis"*), but the bisexual form of one of the short-winged varieties was recognized as a good *Dryophanta* (= our present *Cynips*). The long-winged agamic females of the Southwest were labelled *Dryophanta,* even tho the gall of one of these inspired the name *acraspiformis.*

With this background, the recognition of short-winged and long-winged varieties in the single species *villosa* has left no room to question the close relations of the species that have passed as *Acraspis* and *Dryophanta. Villosa* was first known from two short-winged varieties that have commonly been accepted as congeneric with *pezomachoides,* the genotype of *Acraspis.* But another variety of *villosa,* namely *expositor,* described in the present paper, is found in a gall closely similar to those of varieties *villosa* and *alaria.* The insect of *expositor* has long wings and other characters that show it to be a geographic segregate of the long-winged, *acraspiformis* stock.

This close relation of long-winged and short-winged varieties is shown so often in the present paper that it would be readily acceptable in *Acraspis* except for the fact that all the long-winged varieties have pointed, slender, plough-shaped hypopygial spines, while twenty-three of the short-winged varieties have blunt spines of uniform width. When I first saw this, I had not recognized such variation in the hypopygial spine in any other group of gall making cynipids, and I hesitated for many months to accept it in this group until I became convinced that both types of spine occur within the single species *villosa.*

This conclusion is re-enforced by a detailed examination of the galls of the agamic forms of *Acraspis.* While the large and densely woolly galls of the long-winged *nubila* seem at first glance very different from the naked, faceted galls of the short-

winged *pezomachoides,* they are fundamentally similar as an examination of a series including all of the species of *Acraspis* will show. Enlarged details of these galls are shown in figures 325 to 331. In every case the gall consists of a thickened wall with the larval cell large and without a distinct cell wall. The surfaces of the galls are set with polyhedral bodies that usually terminate in blunt, hair-like spines. These spines are long and flexuous and much tangled when they form the woolly covering of the galls of *nubila;* they are less dense and shorter in some varieties of *villosa* and some galls of *pezomachoides;* they are still shorter, stiffer, and more nearly erect in other varieties of *villosa* and *gemmula;* and they are even lacking, leaving the galls nearly naked in *hirta* and in some of the varieties of *pezomachoides.* These seem to be brilliant indicators of the relationships of these insects. The galls of *Cynips pezomachoides erinacei* offer the best proofs, for within that single variety they vary from the naked to the very spiny form.

The final proofs of the relations of the blunt-spined, short-winged insects are the characters of the bisexual females experimentally and circumstantially connected with two of the agamic forms *(erinacei* and *prinoides)* of eastern *Acraspis.* The bisexual females have hypopygial spines, wing-body ratios, and indications of cubital cell markings that clearly agree with the characters of the long-winged, agamic forms of *nubila* and *acraspiformis.*

For these reasons, the name *Acraspis,* originally established for a group of short-winged, blunt-spined, agamic cynipids, is here applied to a subgenus of *Cynips* that includes both short-winged and long-winged varieties, the latter always with slender, plough-shaped spines.

The assignment of the species *mellea* has involved other questions. The typical variety of the species is a short-winged insect that Ashmead originally considered a *Biorhiza.* Later he made it the type of the genus *Sphaeroteras* because of the character of the frons, the "13-jointed antennae", the rounded scutellum, the length of the hind tarsus, and the indistinct tooth on the tarsal claw. Mayr, studying four of Ashmead's types, pointel out (1902, Verh. zoo.-bot. Ges. Wien 52: 289) that the presence or absence of a carina on the frons was a variable character not even of specific import, that the antennae of *mellea* are really 13-14 segmented with the 14th segment

not always distinct, and that the other characters are not a good basis for distinction from typical *Biorhiza.* My studies of the type material in the National Museum show that Mayr was correct on the antennal count, but both he and Ashmead overlooked the scattering hairs on the mesonotum and the hypopygial spine characteristic of true *Cynips.*

But rather than consider *mellea* the type of a distinct group, *Sphaeroteras,* I am inclined to consider it in the subgenus *Acraspis.* This relation seems attested by the shape of the head, the indefinite malar furrow, the characteristic 13-14 segmented antennae, the punctation and hairs of the mesonotum, the complete parapsidal grooves, the reduced anterior parallel and lateral lines, the lack of median groove, the punctation of the mesopleuron, and the distribution of the hairs on the abdomen. The gall of *mellea* is spherical, thick-walled, and without a distinct larval cell, agreeing in these respects with the species *arida* and *conica* of our *Acraspis,* even tho it lacks the surface spines of the other species of the subgenus. The relation of the short-winged variety *mellea* to the long-winged insects is uniquely verified by the discovery of a variable variety *bifurca (q.v.)* which shows several intermediate stages between the most diverse insects of the species.

An objection to this conclusion will be that the hypopygial spines of the short-winged *mellea* and *bifurca* are like the spines of the long-winged rather than of the short-winged forms of *Acraspis.* We are forced to the conclusion that the blunt spine found in these other short-winged forms is not a necessary accompaniment of the mutation in wing character. Another case bearing on this question is to be found in *Acraspis villosa apache,* which has a plough-shaped spine and wings one-half the normal length.

It is true that the variety *mellea* has nearly simple tarsal claws, instead of the toothed claws found thruout the rest of the genus *Cynips.* This difficulty is cleared up, however, in an examination of other varieties of *mellea.* The galls of the ten varieties are inseparable; but some of the insects (*carolina, unica, rydbergiana, mellea*) show tarsal claws which are nearly simple; others (*crassior, compta, anceps*) show claws that are broader basally and more nearly but not quite toothed. The generic significance of such a "diagnostic character" as the tarsal claw must be questioned when we find it variable within a single species.

Were we to extend Ashmead's conception of *Sphaeroteras* to include the whole species *mellea,* we could not make satisfactory assignments of the Southwestern species *arida* and *conica* which seem to me to be about equally related to *mellea* and to *nubila* and *villosa,* altho these latter species are unquestionably true *Acraspis.* While recognizing the extreme position of *mellea* within the subgenus, I cannot see convenience in or phylogenetic basis for separating it from *Acraspis.*

If our extension of *Acraspis* seems too inconvenient for practical use, it should be admitted that it is sometimes impossible to show true relationships by any simple scheme of classification. Whenever these two functions of taxonomy prove incompatible, I have preferred to show the phylogeny of the group, believing that our data may thereby be best coördinated with the other fields of biologic science. For those who prefer a simpler classification, the older revisions of these groups are still available.

The best structural characteristic of the subgenus *Acraspis* as here defined is the slender, drawn-out, plough-shaped hypopygial spine of some of the forms, or the uniformly wide spine with a blunt, rounded tip in other forms. All the long-winged species except *mellea* and *conica* show at least one smoky patch in the cubital cell, tho this mark is very faint in the bisexual forms. The basically spherical, thick-walled gall without distinct larval cell is a better key to the group than any character of insect structure.

Weld's separation (1922, Proc. U. S. Nat. Mus. 61 (18): 10-12) of *Acraspis* and *Philonix* is good for the species covered. The statement that the adults emerge in the fall, usually before the leaves drop, does not agree with our records for emergence in the group (see the data accompanying any of the well-known varieties, *e.g., erinacei).* In my experience, the life history data for *Acraspis* are so nearly in accord with those for *Philonix* that they furnish some proof of the relations of the two groups.

The conspicuous galls of the agamic forms of *Acraspis* appear late in June or early in July, reaching maturity late in July or in August. The insects pupate sometime later, usually in September, and adults emerge from early in October until the following January, mostly in November further north or December further south. There are no data to show that any

of the insects delay emergence until the second or third years as is sometimes the case in *Philonix.*

Three of the agamic forms (*erinacei, wheeleri,* and *prinoides)* are known to oviposit, soon after emergence, in the dormant buds of the oaks. In these buds the small and inconspicuous galls of the bisexual generations develop early in the spring. These galls develop rapidly, the winged adults, both females and males, emerging within a month or so after the buds first begin to open, ovipositing directly in the leaf veins. This life history may be expected to apply with minor modifications to the other species of the subgenus, unless the more southern varieties have only a single generation (an agamic form) each year.

Cynips (Acraspis) arida, new species agamic form

Figures 57, 290, 291, 333, 354, 403

FEMALE.—In color light brownish rufous, with considerable rufo-piceous; antennae rufo-brown, brownish rufous basally; thorax of normal size; the mesonotum moderately, shallowly punctate and moderately hairy, almost smooth and shining between the punctation especially posteriorly, more roughened anteriorly and laterally; parapsidal grooves narrow and poorly defined especially anteriorly; anterior parallel lines barely evident; lateral lines moderately broad, smooth, and shining; median groove very fine but evident posteriorly; scutellum moderately rugose, almost smooth anteriorly, with the median ridge replaced by a smooth, median strip; the foveal depression rather narrow, smooth at bottom; mesopleuron in large part smooth and shining, sparsely, shallowly punctate and hairy; abdomen dark rufo-piceous, more rufous latero-basally and toward the hypopygium, of normal size, naked except for the patches latero-basally, elongate, the second segment tongue-shaped, covering two-thirds of the whole abdomen; legs light brownish rufous, yellow-rufous at the joints, piceous on the coxae basally; wings long, about 1.30 times the body length, the infuscation on the first abscissa of the radius very large and heavy; the areolet of moderate size to very large; tip of the radius not large but distinctly triangulate; a couple of large, elongate, more or less solid patches in the cubital cell; length 2.2 to 3.2 mm., averaging about 2.8 mm. Figures 354, 403.

GALL.—Small, globular, thick-walled leaf gall with the larval cell filling a large part of the interior. Monothalamous, up to 7.0 mm., averaging under 5.0 mm. in diameter. Strictly spherical when fresh, often shrinking irregularly when dried; the gall sometimes drawn out at the point of attachment; the surface of the gall finely, irregularly

shagreened, covered with a stellate pubescence when young, the older galls becoming more naked but still with a whitish puberulence; the younger galls probably whitish or pinkish, the older galls rather dark purplish brown. The thin outer shell re-enforced with a rather thick mass of not very hard, crystalline material, the larval cell highly variable in size, often occupying most of the interior of the gall, the wall of the cell without a distinct cell wall; on leaves of *Quercus grisea*. Figures 290, 291, 333.

RANGE.—Texas: Alpine (types); Fort Davis.

Probably confined to the mountain ranges of western Texas and adjacent parts of New Mexico; related varieties known to occur in more southern New Mexico and Arizona; probably in Mexico. Figure 57.

TYPES.—22 females, many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, and the U.S. National Museum. Labelled Alpine, Texas; galls December 14, 1919; *Q. grisea;* Kinsey collector.

This is a very common cynipid in western Texas. I have New Mexico and Arizona material that represents at least two other varieties of this species, but none of this material warrants description at this time.

A few of the insects had emerged from the galls which I collected in West Texas in the middle of December (1919). Most of the insects emerged soon after collecting.

It is largely an academic question whether this insect should be considered a variety of *Cynips mellea*, a variety of *Cynips nubila*, or a distinct species showing affinities to both *mellea* and *nubila*. In general appearance the insect is more like *nubila*, the smoky patches on the wing giving it a striking if superficial resemblance to that insect; and in many details of structure it shows more than subgeneric relation to *nubila*. The galls, on the other hand, are so unlike those of *nubila*, and so similar to those of *mellea* that our first decision was to consider this a Southwestern representative of *mellea*. There are, however, few cases of specific identities among the Cynipidae of more eastern and more western Texas.

Cynips (Acraspis) mellea (Ashmead)
agamic forms

FEMALE.—Thorax usually of normal size, in two varieties reduced in size; the mesonotum from almost smooth to finely rugose posteriorly, rougher anteriorly and laterally; parapsidal grooves rather

wide and well defined to the pronotum (except occasionally in *unica*); anterior parallel and lateral lines absent or more or less obscurely defined; median groove absent or evident; scutellum rugose to sculptured, in most varieties more or less raised along a median line which may become a fine ridge anteriorly, the foveal depression smooth to rugose at bottom; mesopleura in large part smooth and shining with some punctation and hairs; abdomen of normal size (long-winged forms) or enlarged (in short-winged forms), largely naked; legs largely rufous, the tarsal claws much broadened basally but nearly simple in some varieties, more nearly toothed in the larger insects; wings long, about 1.30 times the body length, with a complete venation; or wings very much reduced and with remnants of the venation; in the long wings there is a prominent infuscation at the base of the radial cell (over the first abscissa of the radius and the terminal portion of the subcosta), the areolet is small to very large, there is an infuscation at the union of the cubitus and the basalis and one at the break in the discoideus, and the cubital cell is without clouded patches or spots; the insect is 1.8 to 4.5 mm. in length.

GALL.—A small, globular, thick-walled leaf gall with the larval cell filling most of the interior. Monothalamous; strictly spherical when fresh and sometimes when dried after maturity, often shrinking irregularly when dried; the gall sometimes drawn out at the point of attachment; the surface of the gall roughly, irregularly shagreened, densely covered with long, white or brown hairs when young (at least in some varieties), the hairs deciduous, leaving a stellate pubescence on older galls; the galls of all varieties finally naked (altho still appearing puberulent because of the shagreened surface; the naked galls whitish,

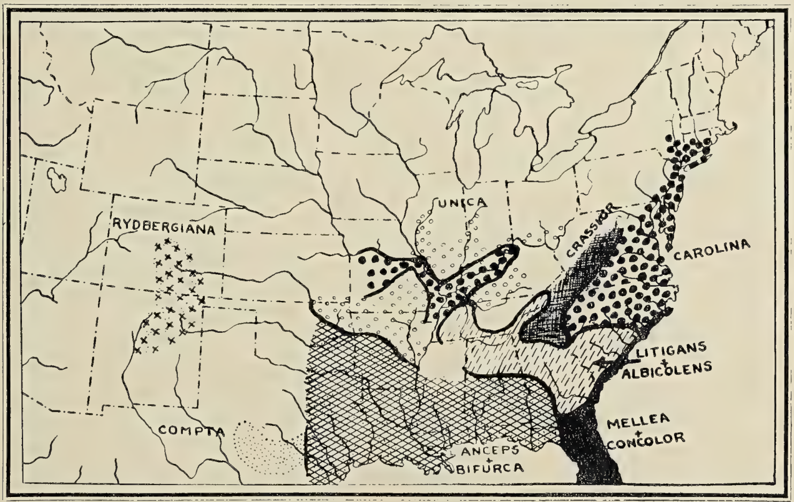


FIG. 50. SUMMARY MAP, VARIETIES OF CYNIPS MELLEA
Each insect geographically isolated or on distinct hosts. Areas of transition and hybridization not shown.

flesh pink or pinkish brown in color; up to 7.0 mm., dried galls averaging about 4.0 mm. in diameter. The thin outer shell re-enforced with a more or less thin, solid mass of crystalline structure; the larval cell highly variable in size, often occupying most of the gall, the wall of the cell hardly differentiated from the solid, crystalline material. Attached to the veins, singly or in small clusters, on the upper or (less often) the under surfaces of leaves of white oaks of all groups.

RANGE.—Known from southern New York to Michigan, Florida, Texas, and northern New Mexico. Probably everywhere in this area; most common in the southeastern quarter of the United States. Figures 50, 51-56.

This species is represented by 11 described varieties with evidence of several others in the United States. The species is largely confined to the southern half of the country east of the Rockies. It is not an uncommon cynipid in that area, but north of the Mason and Dixon's line it is rare. I have nevertheless found stray galls among collections of the similar galls of *Cynips fulvicollis* at localities northward into Michigan. Altho I do not have insects enough to warrant descriptions of this northern material, we may anticipate the extension of the familiar range of *mellea* some day.

In the Southwest, *Cynips arida* and other undescribed forms from New Mexico and Arizona constitute a group so closely related to the present species that it would not have been too misleading to have considered them as varieties of *mellea*.

The galls of *mellea* are not parasitized as often as those of most *Cynips*, and a high percentage of success may attend the breeding of the species. The galls, however, usually prove too young to breed if they are gathered before the first or middle of October, and by that time most of them are fallen from the leaves to the ground where they are difficult to locate. The adults are mature in the galls late in the fall (which further evidences their *Cynips* affinities) and there is the usual winter emergence typical of *Cynips*. Many of the insects of *mellea*, however, delay emergence until March or even later in the spring. The alternate, bisexual generation is unknown.

All of the varieties of the present species (except *bifurca*) are isolated geographically. The several hosts on which the species occurs have had little to do with the development of host varieties, altho *Q. minima*, in Florida, has isolated variety *concolor*, and *Q. alba* thruout a Central Georgia-Tennessee Valley area isolates variety *albicolens*. Each of the other varieties occurs on several oaks, sometimes on as diverse oaks as

Q. alba and *Q. stellata,* with variety *anceps* occurring on six oaks. The chestnut oaks are included among the hosts of the species on the basis of material insufficient for description, but this extends our records to all of the groups of white oaks.

It is difficult to show the varying degrees of relationships between the varieties of *mellea* without seriously complicating our nomenclature. The affinities line up as we might expect from the geographic distribution. The more eastern varieties, *carolina* and *crassior,* are closely related. The southern Appalachian *litigans,* located geographically between *crassior* and *anceps,* is in many respects intermediate between those two, interbreeding with its neighbors wherever it makes contact with one or the other of them. The variety *albicolens* on *Q. alba* belongs to this same group. *Anceps, compta, unica,* and *rydbergiana* form a related series that carries the species west to the southern Rocky Mountain area. In our Southeast we have three varieties, *concolor, mellea,* and *bifurca,* which differ from all the others in being wholly rufous or brownish rufous.

Nine of the varieties of this species are long-winged, but *mellea* and *bifurca* are short-winged. *Bifurca,* however, is a highly variable insect that clearly evidences the origin of the short-winged varieties of Cynipidae by direct mutation from long-winged stocks. These data are further detailed under *bifurca.* The discovery of this insect removes the last excuse for maintaining previous classifications in which *mellea* has been considered a *Sphaeroteras,* with the long-winged insects classified as not well established members of *"Diplolepis"* (= our present *Cynips*).

The generic assignment of *mellea* is discussed in the introduction to the subgenus *Acraspis.*

Cynips mellea variety **rydbergiana** (Cockerell)

agamic form

Figures 51, 386

Dryophanta rydbergiana Cockerell, 1903, Canad. Ent. 35: 217. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 355. Thompson, 1915, Amer. Ins. Galls: 16, 38. Felt, 1918, N.Y. Mus. Bull. 200: 96.

Diplolepis rydbergiana Dalla Torre and Kieffer, 1910, Das Tierreich 24: 370. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 31.

Cynips mellea var. D Kinsey, 1927, Field and Lab. Manual. in Biol.: 110.

FEMALE.—In color black and dark rufous; antennae dark brown, only the first two segments light rufous; mesonotum sparsely, shallowly punctate and sparsely hairy, nearly smooth over much of the area, rougher anteriorly; anterior parallel and lateral lines very obscure or nearly lacking; median groove absent; scutellum quite a little longer than broad, finely rugose, its median ridge distinct but not prominent; foveal groove rather broad, quite smooth and shining at bottom, more nearly divided into foveae than in some of the related varieties; abdomen very dark rufous to black, sometimes with limited, brighter rufous areas basally and ventro-posteriorly; the abdomen hardly elongate, the second segment somewhat tongue-shaped, covering not more than two-thirds of the abdomen; legs bright rufous, a little darker on the coxae basally and on the hind femora and tarsi; wings long, about 1.30 times the body length; areolet of moderate size or a little larger or smaller; cloud on the first abscissa rather limited and light in color; tip of the radius not at all enlarged; body of moderate size, 2.5 to 3.8 mm., averaging 3.2 mm. in length (acc. Weld's record of 88 specimens). Figure 386.

GALL.—Finally naked, flesh-colored to light brown, with little solid material; rounded or flattened basally, occurring singly on the leaves of *Quercus undulata* varieties (*Q. fendleri, Q. rydbergiana*, etc.).

RANGE.—New Mexico: Las Vegas Hot Springs (acc. Cockerell 1903; also acc. Weld 1926). Wagon Mound and Shoemaker (acc. Weld 1926). Figure 51.

Probably confined to a southern Rocky Mountain area in southern Colorado and New Mexico, probably not extending south of the Sandia Mountains in New Mexico.

TYPES.—One damaged and immature female and a piece of a gall; in the U.S. National Museum. From near Las Vegas Hot Springs at about 7,000 feet, New Mexico; the insect cut from the gall March 21, 1903; *Q. rydbergiana;* T. D. A. Cockerell collector (?).

The present re-descriptions are made from this type material and a series collected by Weld at the type locality.

This is the southern Rocky Mountain variety of *mellea*. It occurs on at least two and probably several of the other oaks which are hardly more than varieties of *Q. undulata*.

Weld found mature galls in October and obtained emerging adults on December 31 (1921), January 4 and 20, and February 1 and 6 (in 1922, from galls collected in the fall of 1921), most of the emergence occurring at the later dates. From galls collected in the fall of 1922, Weld secured adults on February 16, 1923. Cockerell cut the type female (dead or alive?) out of a gall on March 21.

Cockerell and later workers have placed this insect in our present genus (known to them as *Dryophanta* or *Diplolepis*),

but with the remark that "it does not exactly agree with any described American genus." Cockerell added that "In Mayr's table, given by Cresson, it runs to *Biorhiza,* but it does not belong there. The gall is like that of *Amphibolips.*"

The mesonotum is more shining in *rydbergiana* than in any other variety of *mellea,* and this and the nearly simple tarsal claw provide the superficial resemblance to *Biorhiza.* The gall, as I understand our cynipid genera, does not have the slightest resemblance to an *Amphibolips* gall. A direct comparison of *rydbergiana* with other varieties of *mellea,* especially with *unica* and *anceps* which are its geographically closest relatives, gives convincing proof of the relationships of all these insects. The gall of *rydbergiana* is quite indistinguishable from the galls of *anceps* and *compta.* While recognizing the extreme position of *mellea* in the subgenus, I have given my reasons, under the subgeneric description, for keeping this species in *Acraspis.*

We owe the recognition of this insect to Weld's collection of a good series from the type locality. *Rydbergiana* would otherwise have to pass in this paper as an unrecognizable name, for the type is a broken and immature specimen that as recently as the summer of 1926 did not convince me of its relations. Thru Mr. Weld's courtesy I have been able to study some of his material and have reached my present conclusions. Altho Cockerell described this insect with 12-segmented antennae, better material shows the 14 segments common to the other varieties of the species.

Cynips mellea variety **unica** (Weld)

agamic form

Figures 51, 387

Diplolepis unica Weld, 1926 (Mo. and northern Ark. records only), Proc. U.S. Nat. Mus. 68 (10): 34, fig. 9.
Cynips mellea var. E Kinsey, 1927, Field and Lab. Manual in Biol.: 110.

FEMALE.—Largely black, dark rufous to rufo-piceous in places, especially about the head; antennae dark brownish rufous, tinged rufous on the first two segments; mesonotum shallowly punctate, moderately hairy, mostly smooth between the punctations, irregularly coriaceous in places; parapsidal grooves not always continuous; anterior parallel and lateral lines rather broad, not prominent, partly smooth, partly roughened; median groove absent; scutellum rather longer than broad, its

median ridge lacking unless at the very anterior point; foveal groove sparingly, shallowly sculptured or almost smooth at bottom; mesopleura largely smooth and shining, almost naked dorsally; abdomen largely black, a little longer than high; the second segment tongue-shaped, well produced dorsally, covering two-thirds or more of the whole abdomen; legs brown to piceous black, dirty yellow at the joints and on the trochanters; wings long, about 1.30 times the body length; areolet large to small, often very small or closed; cloud on the first abscissa of the radius quite small; tip of the radius only slightly expanded; body of moderate size, averaging smaller than *compta* or even *anceps*, but ranging from 2.4 to 4.0 mm. in length. Figure 387.

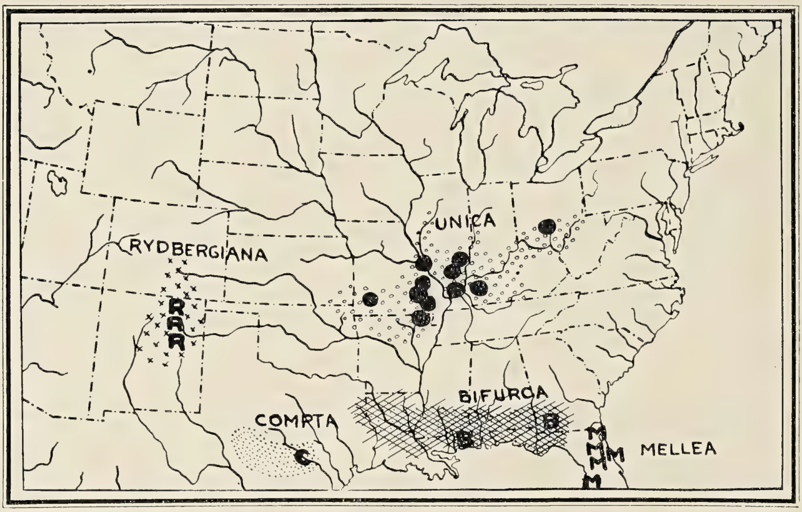


FIG. 51. SOME VARIETIES OF CYNIPS MELLEA
Possible extensions of known ranges shown by shading.

GALL.—As described for the species, becoming white and naked when mature; usually rounded or flattened basally; occurring singly or clustered, on the leaves of *Quercus stellata.*

RANGE.—Illinois: America, Olney, and Christopher (Kinsey coll.).

Missouri: Ironton (Weld coll., types). Arcadia and 6 miles west of Dexter (Kinsey coll.). St. Louis (gall in U.S. Nat. Mus.). Poplar Bluff (acc. Weld 1926). 10 miles southeast of Springfield (R. Voris in Kinsey coll.).

Arkansas: Hoxie (galls, acc. Weld 1926).

Kentucky: Dawson Springs (Kinsey coll.).

Ohio: Chillicothe (Kinsey coll.).

Probably centering in the Ozarks of Missouri and more northern Arkansas, but extending eastward into the hills of southern Illinois, Kentucky, and southeastern Ohio. Figure 51.

TYPES.—Holotype and 3 paratype females and galls in the U.S. National Museum. Paratype females in the American Museum, Field Museum, Stanford University, Philadephia Academy, and Kinsey collections. From Ironton, Missouri; galls October, 1917; adults May 15, 1918; *Q. stellata;* Weld collector.

The present re-descriptions are made from the holotype and seven of the paratypes.

I found not fully mature galls of *unica,* which, however, were already dropping from the leaves of the post oaks, in southern Illinois during the second week of October (1927), and in southeastern Missouri and southern Ohio during the last week in October (1926). Live adults were in galls from western Missouri on November 21 (1928). I have bred adults on December 12, on March 22, during the last week of March, and an April 10. From the galls which Weld collected in Missouri in October, he bred adults at Chicago on May 15, 1918.

The distribution data for this variety are typical for an Ozark cynipid. The hills of western Kentucky and southern Illinois, which are geologically of the same origin as the body of the Ozarks in Missouri and northern Arkansas, contain an interesting extension of the Ozark fauna. The Mississippi Valley in this region has a Coastal Plain fauna. Two of my forty insects of this species from Dexter, Missouri, represent *unica,* the other 38 being the typical Coastal Plain *carolina.* Dexter stands at the boundary between the lowlands of the Mississippi and the uplands of southern Missouri. The single insect from my Poplar Bluff collection has an interesting combination of *unica, rydbergiana,* and *compta* characters. Weld's records (1926) for *unica* in southern Arkansas and in Texas, based on galls only, probably apply to *anceps,* and his Florida record to variety *mellea.* I cannot interpret his Virginia record (Pergande collection), but I question the occurrence of *unica* that far east.

While the areolet in all of the type series is moderately small to closed, one large adult which I collected at Arcadia, Missouri (very near the type locality), has an areolet of considerable size.

Cynips mellea variety **compta,** new variety
agamic form

Figures 51, 296-298, 350, 355, 388

FEMALE.—In general color reddish rufous and black; antennae dark brown, the first two segments light rufous; mesonotum moderately, shallowly punctate and moderately hairy, finely coriaceous or shagreened posteriorly, irregularly roughened elsewhere between the punctations; anterior parallel and lateral lines rather broad, for the most part punctate or roughened; median groove almost absent; scutellum hardly longer than broad, coarsely rugose to sculptured, its median ridge not prominent; foveal groove more or less smooth at bottom; abdomen dark rufo-piceous, more rufus antero-laterally, only a bit longer than high; the second segment more extended dorsally but not tongue-shaped, covering at least half of the abdomen; legs dark rufous, light rufous at some of the joints and on the trochanters; wings long, about 1.30 times the body length; areolet large to very large; cloud on the first abscissa of the radius larger than in *anceps;* tip of the radius distinctly enlarged; body generally larger and heavier than in *anceps,* 3.5 to 4.5 mm., averaging almost 4.0 mm. in length. Figures 350, 355, 388.

GALL.—Naked when mature, becoming pinkish brown or darker in color; with little solid material; rounded or flattened basally; occurring singly on leaves of *Quercus stellata.* Figures 296-298.

RANGE.—Texas: Austin (Patterson, types; also Kinsey coll.).

Probably confined to an area extending (westward?) from Austin, Texas. Figure 51.

TYPES.—33 females, 4 clusters of galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females at the Museum of Comparative Zoölogy, the U.S. National Museum, the California Academy, and the American Museum of Natural History. Labelled Austin, Texas; galls August 15, 1921, insects February 9, 1922; *Q. stellata;* Patterson collection 138.

The Patterson material (numbers 9, 127, and 138) represents nearly full-sized galls gathered August 15 (in 1921) and at later dates. Galls I gathered at Austin on December 4 (in 1919) contained mature adults which did not emerge until some time later. Patterson found mature adults beginning to gnaw out on January 28 (in 1923), and he records them emerging on February 1 (in 1923) and February 9 (in 1922).

The younger galls are hairy, later losing all but a stellate pubescence, finally (before the first of December) becoming entirely naked. These various stages might pass for galls of different species, but there are no other differences in the galls and none in the adults.

Four years ago Mr. Rohwer kindly compared material of the present variety with the type of *carolina* at the U. S. Na-

tional Museum. He pointed out the distinct characters of the two insects and saw the close resemblances of the galls. The insect of *compta* is abundantly distinct from all the other varieties of this species except *anceps*. The ranges of *compta* and *anceps* overlap at Austin, and 7 of the 60 insects I have from Austin appear intermediate between the two varieties. There is no apparent reason why they should not interbreed in that region, but material from more eastern Texas is entirely *anceps*. As soon as the geographic isolation is sufficient, the two insects maintain themselves as distinct.

Cynips mellea variety **anceps,** new variety agamic form

Figures 52, 337, 389

Diplolepis carolina err. det. Weld, 1926 (Ark. and Tex. records only), Proc. U.S. Nat. Mus. 68 (10) : 22.

Diplolepis unica err. det. Weld, 1926 (Ark., Tex., and some Fla. records only), Proc. U.S. Nat. Mus. 68 (10) : 35.

Cynips mellea var. A Kinsey, 1927, Field and Lab. Manual in Biol.: 109.

FEMALE.—In color reddish rufous and black; antennae dark brown, the first two segments light rufous; mesonotum moderately, shallowly punctate and moderately hairy, very finely coriaceous posteriorly, irregularly roughened elsewhere between the punctation; anterior parallel and lateral lines rather broad, for the most part punctate or roughened; median groove almost absent; scutellum a little longer than broad, coarsely rugose, its median ridge more or less evident; foveal groove broad, more or less smooth at bottom; abdomen dark rufous to piceous, hardly elongate, the second segment somewhat tongue-shaped, covering two-thirds of the abdomen; legs dark rufo-brown, light rufous at some of the joints and on the trochanters; wings long, about 1.30 times the body length; the areolet of moderate size to small; cloud on the first abscissa of the radius of moderate size, smaller than in *compta;* tip of the radius hardly at all enlarged; body generally smaller and more slender than *compta,* 3.0 to 4.0 mm., averaging about 3.5 mm. in length. Figures 337, 389.

GALL.—Pubescent when young, finally naked, whitish to flesh-colored; rounded or flattened at base; occurring singly on the leaves of *Quercus alba, Q. stellata, Q. floridana* (and *Q. Margaretta?*), *Q. Chapmanni,* and *Q. breviloba.*

RANGE.—Arkansas: Little Rock, Hot Springs, and Texarkana (*Q. stellata,* galls, acc. Weld 1926). Hope (galls, L. Knobel in Kinsey coll.).

Texas: Arlington, Palestine, Trinity, Cuero, College Station, and Houston (*Q. stellata,* galls, acc. Weld 1926). Boerne (*Q. stellata* and *Q. breviloba,* galls, acc. Weld 1926). Austin (*Q. breviloba,* Patterson coll., types; also *Q. stellata,* galls, acc. Weld 1926). Round Rock,

Hearne, West Point, and Sinton (*Q. stellata,* Kinsey coll.). Leander (*Q. breviloba,* Kinsey coll.).

Mississippi: Pass Christian (*Q. stellata,* galls, Kinsey coll.).

South Carolina: Hardeeville (Kinsey coll.).

Georgia: Barnesville (*Q. stellata,* Kinsey coll.). Henderson (hybrids, on *Q. floridana,* Kinsey coll.). Valdosta (*Q. Chapmanni,* Kinsey coll.). 6 miles north of Trion (*Q. alba,* Kinsey coll.).

Alabama: Elmore and Athens (*Q. stellata,* Kinsey coll.). 5 miles south of Troy (hybrid with *litigans,* on *Q. floridana,* Kinsey coll.). Pelham (hybrid with *litigans,* on *Q. stellata,* Kinsey coll.).

Florida: Milton (*Q. alba,* Kinsey coll.). Campbellton (*Q. alba; hybrid with albicolens;* Kinsey coll.). Wakulla (*Q. floridana,* Kinsey coll.). Madison (galls, acc. Weld 1926).

Probably thruout more eastern Texas, Oklahoma, and parts of Arkansas, eastward along the Gulf Coast to western Florida, extending northward across half of Alabama and Georgia (but further north only as hybrids with *crassior* and *litigans*). Figure 52.

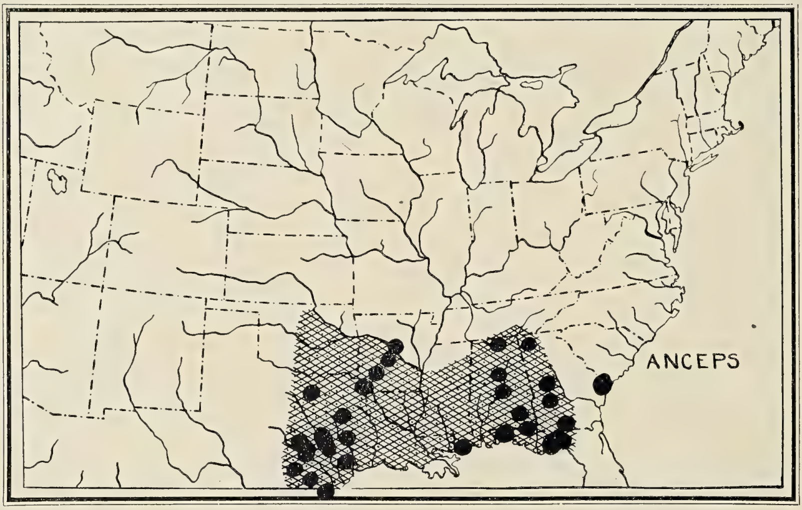


FIG. 52. GULF COAST VARIETY OF CYNIPS MELLEA

Possible extension of known range shown by shading.

TYPES.—7 females, 10 galls. Holotype and paratype females and galls in the Kinsey collection. A paratype female and galls in the U.S. National Museum. Labelled Austin, Texas; galls January 28, 1923; insects February 1, 1923; *Q. breviloba;* Patterson collection number 127. The types (and other Patterson material) were preserved for a time in alcohol, and the rufous areas are consequently brighter than in material preserved dry.

Patterson cut live insects from galls of *anceps* on January 25 and 28, and secured emerging adults at Austin, Texas, on February 2 and 7 (1923). I have bred Alabama, Georgia, and

Florida insects on January 20, February 7, and March 23 (all in 1928).

This insect is very close to the Central Texas *compta,* with which *anceps* appears to interbreed at Austin. The data on the development of *anceps* and *compta* are, as far as we know them, parallel. The material of *anceps* from the area in Texas east of Austin is quite uniform. I see no constant differences between the *Q. breviloba* and *Q. stellata* material from Texas and the *Q. alba, Q. floridana, Q. Margaretta,* and *Q. Chapmanni* material from western Florida, southern Georgia, and southern Alabama. Elsewhere in Alabama and Georgia *Quercus alba* isolates a distinct variety, *albicolens.* The wide extension of the range of *anceps* is an example of what we may expect to learn about others of the East Texas species when we have extended our explorations in the South. Our series are large enough to eliminate uncertainties in our determinations of this eastern material of *anceps,* altho we have no material to show where the variety may occur in the Mississippi Valley and the state of Mississippi.

It will be understood that thruout most of Georgia and Alabama *anceps* is replaced by variety *litigans* on *Q. stellata* and *albicolens* on *Q. alba,* while in the southern Appalachian area, *crassior* is the common representative of our present species. The records for *anceps* occuring north of the Gulf area represent only a small percentage of our collections. We have the short-winged variety *bifurca* from southern Mississippi and southern Georgia from localities well within the range of *anceps,* and I do not yet know what isolation factors keep the two insects distinct. Still further to the east, *anceps* meets the Coastal Plain variety *mellea* in northern Florida, but we lack collections to show where the two insects come together. In northern Arkansas, *anceps* gives way to the Ozark variety *unica.*

Cynips mellea variety **bifurca,** new variety agamic form

Figures 51, 294-295, 338-339, 357-360, 390

FEMALE.—Largely bright rufous, the legs and antennae often entirely yellow rufous, smaller specimens lighter in color, larger specimens darker rufous with piceous or black edges to the thoracic plates, with the terminal halves of the antennae and the legs in part dark brown and the head and abdomen in part rufo-piceous; the thorax somewhat reduced, most so in the specimens with the shortest wings,

only slightly reduced in larger-winged individuals; the mesonotum largely smooth and shining, entirely naked in smaller specimens, scatteringly punctate and hairy in larger specimens; anterior parallel and lateral lines barely indicated (in larger specimens) or entirely lacking (in smaller specimens); median groove always lacking; scutellum moderately rugose, more or less reduced, most so in the smallest specimens where it is hardly longer than wide and without a median ridge; the scutellum distinctly elongate in larger specimens and with a fine median ridge anteriorly; the scutellum depressed anteriorly; in all cases with a definite ridge separating the scutellum from the rest of the mesonotum; the abdomen swollen and not produced dorsally (in smaller specimens) or nearly normal in size and distinctly produced dorsally (in larger specimens); in the latter case the second segment covers two-thirds or more of the whole abdomen; wings reduced, of strikingly variable length, measuring from 0.27 to 0.54 of the body length, the smallest wings rounded at the tip, with only the basal portion of the subcosta, the second abscissa of the radius, and the basalis distinct; the larger wings abruptly truncate and bifurcate apically, with practically a complete altho contracted venation in which the areolet is closed; insects of highly variable size, from 2.2 to 3.3 mm. in length. Figures 338-339, 357-360, 390.

GALL.—Typical for the species; quite small; rounded or flattened basally; occurring singly on the leaves of *Quercus stellata* and *Q. floridana* (incl. *Q. Margaretta*?). Figures 294-295.

RANGE.—Georgia: Fender (*Q. floridana,* Kinsey coll.).
Mississippi: Picayune (*Q. stellata,* types, Mrs. W. E. Smith coll.).
Possibly restricted to some area (as yet unrecognized) lying just back of the more eastern Gulf Coast; or possibly still scattered in the range of the apparently parental form, *anceps.* Figures 51.

TYPES.—11 females and 36 galls in the Kinsey collection. Labelled Picayune, Mississippi; galls October 22, 1927; insects February 6, 1928; *Q. stellata;* Mrs. W. E. Smith collector.

The type galls were collected in October and gave adults on February 6 (1928). Five insects from Fender, Georgia, were bred on March 26 (1928). The small, sub-apterous, bright rufous insects run about as actively and emit as strong an ant (formic acid) odor as any of the other short-winged Cynipidae, many of which possess those same peculiar characteristics.

From a phylogenetic standpoint, this is one of the most interesting insects in the genus *Cynips.* While the wing-body ratio is a remarkably constant character among most Cynipidae, even among short-winged forms, the wings of *bifurca* vary from 0.27 to 0.54 of the body length. Within this range of variation, the insect provides remarkable evidence of the relations between the short-winged *mellea* and the long-winged

species treated in this study. The shortest wings of *bifurca* have a venation closely resembling that of *mellea,* and the insect with those wings has so nearly the same honey-rufous color and the same general form as *mellea* that no one would question the relations of the two. On the other hand, the longer-winged individuals of *bifurca* show a venation which, while reduced, is nevertheless complete and characteristic of the long-winged members of the subgenus, showing the same short and broad radial cell and the uniquely stout second abscissa of the radius that one finds in varieties *carolina, crassior, anceps,* etc. These larger individuals of *bifurca* even take on much of the piceous black color characteristic of the long-winged varieties, and the body proportions, the surface and hairy coating of the thorax, and the surface of the scutellum, even to the median ridge of the scutellum, are so much like those of the long-winged *anceps* that the relationship seems certain. In short, here is the evidence that direct mutation within a single population in nature may account for the apparently great but phylogenetically superficial differences between the short-winged *mellea* and the long-winged *anceps, carolina, compta, unica,* etc.

Bifurca is the only short-winged cynipid known with a truncate and bifurcate apex to the wing. This is the typical "truncate wing" of *Drosophila* laboratory mutations. The shortest-winged individuals of *bifurca* show the pointed tip to the wing that is characteristic of all other short-winged Cynipidae.

It is of further interest to find that the reduction of the venation in *mellea* follows a pattern that is very different from that of *bifurca* (shown in figs. 356 to 360). This can only mean that the two mutations have occurred independently from long-winged stocks, and is further evidence for believing that the short-winged Cynipidae represent varieties or species that are relatively recent and direct mutations of long-winged varieties or species.

Cynips mellea variety **litigans**, new variety agamic form

Figures 53, 391

FEMALE.—In color largely black with some rich (not bright) rufous; the head largely rufous; the antennae nearly black, rufous on the first two segments and at the tip of each other segment; mesonotum rather closely punctate and hairy, finely roughened between the puncta-

tion; anterior parallel and lateral lines rather broad, not entirely smooth; median groove hardly evident; scutellum no longer than broad, moderately rugose, with the median ridge hardly evident; foveal groove broad, largely rugose at bottom; abdomen entirely black, not elongate, the second segment not tongue-shaped, covering two-thirds or more of the abdomen; legs nearly black, rufous at some of the joints and on the trochanters; wings long, about 1.30 times the body length; the areolet of moderate size only; cloud on the first abscissa of the radius of moderate size; tip of the radius hardly at all enlarged; quite robust insects 3.0 to 4.0 mm. in length. Figure 391.

GALL.—Typical for the species, averaging rather large; rounded or flattened basally, occurring singly on the leaves of *Quercus stellata* and *Q. floridana* (or *Q. Margaretta*?).

RANGE.—Alabama: Athens (types). 5 miles south of Troy, and at Elmore (Kinsey coll.).

Georgia: Henderson and Madison (Kinsey coll.).

South Carolina: Bonneau (Kinsey coll.).

Tennessee: Oakdale (Kinsey coll.).

North Carolina: Hendersonville (Kinsey coll.).

Ohio: Chillicothe (Kinsey coll.).

Probably confined to a southern Appalachian area, from south-eastern Ohio into northern Georgia and Alabama. Figure 53.

TYPES.—13 females and 71 galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History and the U.S. National Museum. Labelled Athens, Alabama; galls November 16, 1927; insects March 14, 1928; *Q. stellata;* Kinsey collector.

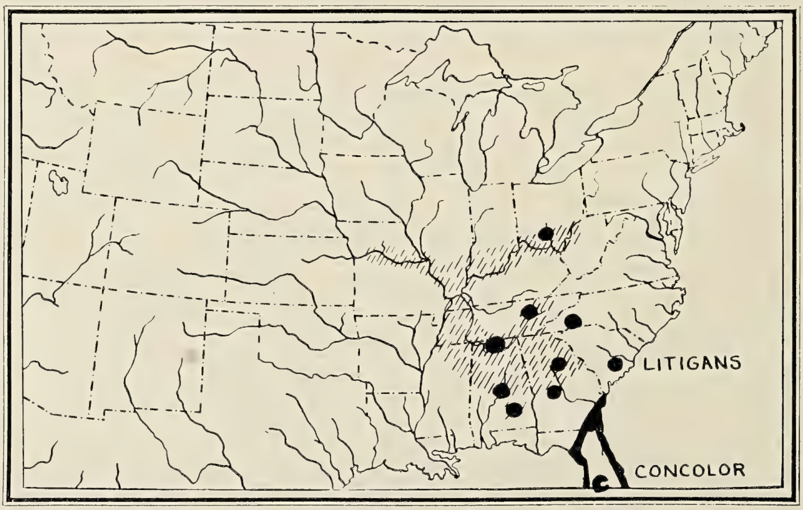


FIG. 53. TWO VARIETIES OF CYNIPS MELLEA

Possible extensions of known ranges shown by shading.

Insects of this variety were bred on January 2 and 20, February 6, March 14, and April 1, 10 and 19 (in 1928 and 1929).

The adult of *litigans* is large and conspicuously black, and consequently readily separated from *crassior* which replaces *litigans* in most of Georgia and Alabama, and in the Tennessee Valley in Tennessee. The galls of *crassior,* moreover, occur in clusters and they are drawn out to a conical base, while the galls of *litigans* are rounded or flattened basally, so the two are to be distinguished in the field. *Litigans* is distinctly Appalachian in its distribution. This range and the great variability of the insect suggests that *litigans,* like other southern mountain varieties of *Cynips,* may have had a hybrid origin with a northern parent that was pushed southward in the mountains during the Pleistocene. We have not recognized such a northern variety of *mellea,* and consequently cannot analyze *litigans* at this time. We have numerous insects which seem intermediate between *litigans* and its southern neighbor, *anceps,* and a few individuals that may be hybrids of *litigans* and *crassior.*

Cynips mellea variety **concolor,** new variety agamic form

Figures 53, 392

FEMALE.—Wholly brownish rufous, the head and thorax bright brownish rufous, the abdomen more reddish rufous; antennae wholly brownish rufous except the two terminal segments which are dark brown; mesonotum moderately punctate and hairy, microscopically reticulated between the punctations posteriorly, almost smooth anteriorly and laterally; anterior parallel lines indicated but not at all smooth, lateral lines more evident, broad, but not wholly smooth; median groove distinct at the scutellum, evident for some distance anteriorly; scutellum longer than broad, coarsely rugose, the median ridge rather distinct; foveal groove broad, more or less smooth at bottom; abdomen uniformly bright red rufous, rather elongate, the second segment somewhat elongate dorsally but not covering much more than half the whole abdomen; legs wholly light brownish rufous, more rufous on the hind tibiae; wings long, about 1.30 times the body length; the areolet of moderate size; cloud on the first abscissa of the radius of moderate size; tip of the radius not at all enlarged; 4.0 mm. in length. Figure 392.

GALL.—Naked when mature, becoming light pinkish brown; averaging large for the species; rounded or flattened basally, occurring singly on leaves of *Quercus minima.*

RANGE.—Florida: Bowling Green (Kinsey coll.).

Probably confined to *Q. minima* on the peninsula of Florida and an adjacent area in Georgia. Figure 53.

TYPES.—1 female and 1 gall in the Kinsey collection. Labelled Bowling Green, Florida; gall November 13, 1919; *Q. minima;* Kinsey collector.

While this insect is in color very different from all of the other varieties except *mellea* and *bifurca,* it is not more than varietally distinct from *carolina, compta,* and the other rufous and black insects. It is interesting to find both of the described varieties from Florida light yellowish rufous in color. Variety *mellea* is described from *Q. stellata,* and the present insect, *concolor,* is from *Q. minima.* It may be this host isolation that keeps the two varieties distinct, for *Q. minima* is a live oak and does not belong to the *Q. alba* and *Q. stellata* groups of oaks that are common in the Southeast.

It is to be regretted that we have so little material of *concolor.*

Cynips mellea variety **mellea** (Ashmead) agamic form

Figures 51, 356, 393

Biorhiza mellea Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128, 138. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 310. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 110. Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 289. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 245 (*not* pl. 42 fig. 3, 4). Dalla Torre and Kieffer, 1910, Das Tierreich 24: 401, 815, 834. Felt, 1918, N.Y. Mus. Bull. 200: 90, (*not* fig. 84 (3, 4)).

Biorrhiza mellea Dalla Torre, 1893, Cat. Hymen. 2: 61. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 56.

Sphaeroteras mellea Ashmead, 1897, Psyche 8: 67. Thompson, 1915, Amer. Ins. Galls: 15, 42.

Diplolepis carolina err. det. Weld, 1926 (Fla. records only), Proc. U.S. Nat. Mus. 68 (10): 22.

Diplolepis unica err. det. Weld, 1926 (Fla. records only), Proc. U.S. Nat. Mus. 68 (10): 35.

Cynips mellea var. C Kinsey, 1927, Field and Lab. Manual in Biol.: 110.

FEMALE.—Almost wholly light brownish rufous, including the antennae and the legs with the coxae, the abdomen more yellowish rufous; thorax reduced, narrow, the mesonotum largely smooth and shining but very minutely roughened and sparingly hairy; anterior parallel and lateral lines and median groove lacking; scutellum much reduced, hardly longer than wide, very finely rugose, depressed an-

teriorly but without any other foveal groove; only an indefinite ridge separating the scutellum from the rest of the mesonotum; abdomen rather swollen, the second segment covering about one-half the whole abdomen; wings very short, about 0.47 of the body in length, with no more than traces of veins, chiefly back of the basalis; the hind wings but mere scales; the insects 1.8 to 2.0 mm. in length. Figures 356, 393.

GALL.—Typical for the species, averaging small; on the leaves, often in small clusters, on *Quercus stellata* and its varieties, probably including the related *Q. Chapmani* and *Q. Margaretta.*

RANGE.—Florida: Jacksonville (Ashmead; types). Greencove Springs, Ocala, Clearwater, St. Petersburg, and Daytona (galls, acc. Weld 1926).

Probably restricted to *Q. stellata* and its varieties in the Southeast, perhaps to Florida and adjacent parts of Georgia. Figure 51.

TYPES.—8 females and galls. Holotype and two topotypes in the U.S. National Museum; 4 adults in the Mayr collection (at Vienna?); galls in the Philadelphia Academy. From Jacksonville, Florida; bred in February; "*Q. parvifolia*" (= *Q. stellata* or *Q. Chapmani* var.); Ashmead collector.

The present re-descriptions are made from the types at the U.S. National Museum.

We have no insects of this variety except those of Ashmead's type collection. These adults were bred in February. His host record, *Q. parvifolia,* is ordinarily taken to mean *Q. Chapmani,* an oak so closely related to *Q. stellata* that there is, as far as I know, no distinction in the cynipid faunas of the two.

The galls of variety *mellea* cannot be separated from those of *carolina.* All of the insects thus far bred from Coastal Plain material, from the Carolinas and north, have proved to be the long-winged, rufous and black variety *carolina,* and Beutenmüller's record of *mellea* in New Jersey, apparently based on galls alone, is probably a mis-determination. His published figures of *mellea* galls appear to have been based on this New Jersey material.

The relationships of the short-winged *mellea* and the long-winged varieties here treated as belonging to the same species, and the position of *mellea* in our present subgenus, are discussed in the general treatment of *Acraspis* and in the introduction to our present species. In southern Georgia and Mississippi there is another short-winged variety, *bifurca,* which resembles *mellea* in many respects, altho it has a wing venation of such a distinctly different type that we must consider *mellea* and *bifurca* independent mutations from the long-winged stock of the species.

Cynips mellea variety **carolina** (Ashmead) agamic form

Figures 54, 292-293, 334, 348, 394

Dryophanta carolina Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128, 145. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 310. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 109. Dalla Torre, 1893, Cat. Hymen. 2: 49. Kieffer, 1901, André Hymén. d'Europe 7 (1): 621. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Beutenmüller in Smith, 1910, Ins. N.J.: 599. Thompson, 1915, Amer. Ins. Galls: 12, 37. Felt, 1918, N.Y. Mus. Bull. 200: 78, fig. 97 (4).

Biorhiza mellea err. det. Beutenmüller, 1909 (N.J. record only), Bull. Amer. Mus. Nat. Hist. 26: 245, pl. 42, fig. 3, 4. Beutenmüller in Smith, 1910, Ins. N.J.: 598. Felt, 1918, N.Y. Mus. Bull. 200: fig. 84 (3-4). Err. det. Wells, 1921, Bot. Gaz. 71: pl. 22 Cynipid 14.

Diplolepis carolina Dalla Torre and Kieffer, 1910, Das Tierreich 24: 365, 813. Weld, 1926 (in small part), Proc. U.S. Nat. Mus. 68 (10): 22.

Cynips mellea var. B Kinsey, 1927, Field and Lab. Manual in Biol.: 109.

FEMALE.—In general color reddish rufous and black; the apical halves of the antennae rufo-brown, whole basal halves rufous, the first two segments lighter rufous; mesonotum very sparingly punctate and hairy, almost entirely smooth and shining posteriorly, more roughened anteriorly and laterally; anterior parallel and lateral lines barely indicated, slightly raised, rather broad; median groove more or less evident but indefinite; scutellum hardly longer than broad, coarsely rugose, its median ridge rather prominent at least anteriorly where it divides the foveal groove; foveae broad, sparsely rugose at bottom; abdomen bright rufous, slightly darker rufous in places, distinctly longer than high, the second segment distinctly tongue-shaped, covering almost three-quarters of the whole abdomen; legs, including the coxae, mostly bright rufous; wings long, about 1.30 times the body length; areolet of moderate size or smaller; cloud on the first abscissa of the radius of moderate size; tip of the radius hardly enlarged; body generally slender and light in weight, length 2.6 to 3.2 mm., distinctly smaller than other varieties. Figures 348, 394.

GALL.—Woolly when young, becoming naked when mature, then light pinkish brown in color; averaging smaller than variety *crassior;* usually drawn out to a conical base; usually clustered, on the leaves of *Quercus alba* and *Q. stellata.* Figures 292-293, 334.

RANGE.—New York: Nyack (Zabriskie in U.S. Nat. Mus.).

New Jersey: Fort Lee and Lakehurst (acc. Beutenmüller 1910). Richland and Carmel (Kinsey coll.).

Virginia: Eastville and Cape Charles (Kinsey coll.).

North Carolina: Asheville (Ashmead, types). Maysville, Marshall, and Cherokee (Kinsey coll.).

Kentucky: Dawson Springs (gall, Kinsey coll.).

Tennessee: Newport (Kinsey coll.).

Missouri: 6 miles west of Dexter (Kinsey coll.). Springfield (R. Voris in Kinsey coll.).

Probably thruout the Coastal Plain of the northeastern United States, from southern New York to North Carolina and Tennessee and in the Mississippi Valley from southern Indiana to Missouri. Figure 54.

TYPES.—2 females and 1 gall in the U.S. National Museum. From Asheville, North Carolina; collected October, 1886; reared February, 1887; *Q. alba;* Ashmead collector.

The present re-descriptions are made from these types compared with material from numerous localities in the Coastal Plain area.

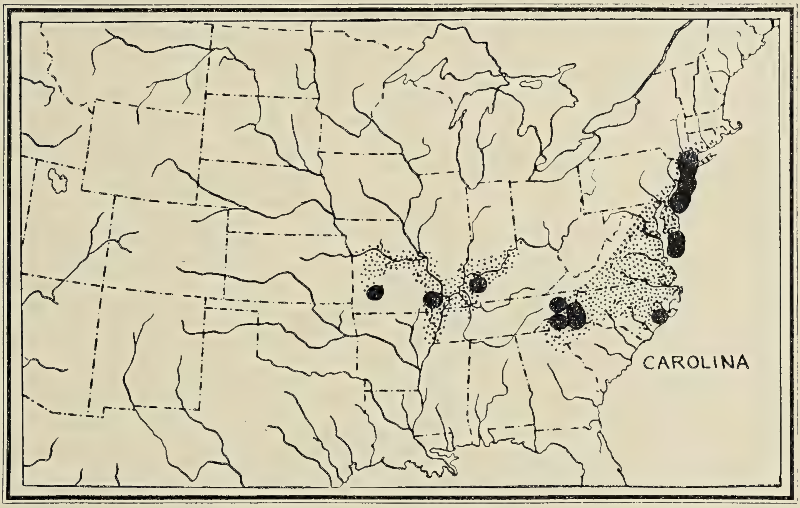


FIG. 54. COASTAL PLAIN VARIETY OF CYNIPS MELLEA
Showing remnants of possibly more ancient Middle-Western range.

This is the common eastern variety of the species, well known to all who have observed galls in the Atlantic Coastal Plain region. It occurs westward to the Great Smokies of the North Carolina-Tennessee boundary, and also at Newport, Tennessee, immediately west of the mountains. At higher elevations in the mountains themselves, from Ohio to northern Georgia and Alabama, variety *litigans* represents the species. In the heart of Georgia and Alabama, and at a few points further north, variety *crassior,* a close relative of *carolina,* replaces the Coastal Plain variety. Extensive field work in Tennessee, Georgia, and Alabama failed to disclose *carolina*

occurring west of the Appalachians until we found it in western Kentucky and southern Missouri where I have recovered fine series of the insects. From west of Dexter, in the southeastern corner of Missouri, collections made on a small clump of *Q. stellata* scrub, located very near the fault that separates the river lowlands from the highlands, gave me forty insects, two of which represent the Ozark variety *unica* and 38 of which are typical *carolina*. From Springfield, from near the southwestern corner of Missouri, I have 25 insects, 9 of which are *unica* and 16 of which are *carolina*. The insect is so unique as to leave no possibility of mis-determination, and the galls of *unica* and *carolina* are similarly distinct, so there can be no doubt of the occurrence of the Atlantic Coastal Plain variety all the way across the state of Missouri.

Except for the type collections, all of the insect material I have examined has come from *Q. stellata* (the post oak), to which the variety seems largely confined. The type specimens recorded as from *Q. alba* seem no different from this *Q. stellata* material unless the insects average a little smaller in size. Beutenmüller's record (in Smith, 1910, Ins. N.J.: 599) of similar galls on *Q. prinoides* (the chinquapin oak), and specimens I have from this same oak from Roselle, N. J. (C. J. Long, Jr., coll.) will probably prove to belong to another variety. Weld's record of *carolina* from *Q. stellata* at Ironton in the Missouri Ozarks should be re-examined in connection with the numerous varieties now described.

Beutenmüller records the galls as occurring in August, September, and October. I have found mature galls still attached to the leaves in the middle of October in southern New Jersey and Virginia, and at the end of October in the mountains of the western part of North Carolina and eastern Tennessee. The galls I collected at Dexter, Missouri, late in October (1926), were mature and dropping from the trees, but the insects did not emerge until the following March. I have bred other material early in January. Weld collected galls in October from which he reared adults in the following June, but this seems late emergence for a species in which the other known varieties emerge in the late winter or early spring.

One of my insects from Marshall, North Carolina, seems identical with typical *carolina* from the same locality except that it is almost entirely piceous in color.

Cynips mellea variety **crassior,** new variety agamic form

Figures 55, 395

FEMALE.—In general color reddish rufous and black; apical halves of antennae rufo-brown, whole basal halves rufous, the first two segments lighter rufous; mesonotum very sparingly punctate and hairy, almost entirely smooth and shining posteriorly, more roughened anteriorly and laterally; anterior parallel and lateral lines indicated, slightly raised, rather broad; median groove irregular but defined posteriorly; scutellum distinctly longer than broad, distinctly sculptured, its median ridge rather prominent, extending anteriorly to divide the foveal groove; foveae broad, rugose at bottom; abdomen bright rufous, slightly darker rufous in places, distinctly longer than high, the second segment distinctly tongue-shaped, covering almost three-quarters of the whole abdomen; legs, including the coxae, mostly bright rufous; wings long, about 1.30 times the body length; areolet of moderate size or smaller; cloud on the first abscissa and infuscation on the second abscissa of the radius rather large; tip of the radius only slightly enlarged; body generally large and stout, 3.5 to 4.0 mm. in length. Figure 395.

GALL.—Scatteringly pubescent or more naked when mature, light grayish brown in color; large galls, with rather thin walls; usually drawn out to a conical base; occurring in clusters (conspicuously so); on the leaves of *Quercus stellata* (and *Q. alba*?).

RANGE.—Virginia: Indian Rock (Kinsey coll.).

Tennessee: Charleston and Oakdale (Kinsey coll.). 9 miles northeast of Chattanooga (galls, Kinsey coll.).

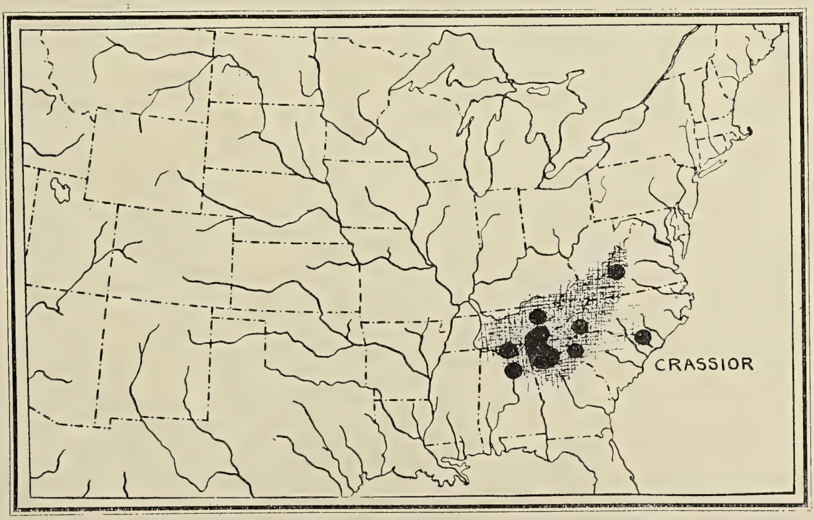


FIG. 55. SOUTHERN APPALACHIAN VARIETY OF C. MELLEA

North Carolina: Chadbourn and Hendersonville (Kinsey coll.).

Georgia: Acworth (types), Rome, and 6 miles north of Trion (Kinsey coll.). Hartwell (galls, Kinsey coll.).

Alabama: Athens and Pelham (Kinsey coll.).

Probably confined to *Q. stellata* and its very close relatives (not *Q. alba*), occurring thruout Central Georgia and Alabama and in the Tennessee River Valley of Tennessee, northward into Southern Virginia and North Carolina. Possibly to be expected in the southern Ohio River Valley. Figure 55.

TYPES.—7 females and 20 galls. Holotype and paratype females and galls in the Kinsey collection. Paratype galls in the U.S. National Museum and the American Museum of Natural History. Labelled Acworth, Georgia; galls November 10, 1927; *Q. stellata;* Kinsey collector.

My material of *crassior* represents mature galls collected as early as October 20 (1919) in western Virginia. I have insects bred during the first week in February, on March 14 and 26, and on April 1 and 10.

With its distinctly sculptured and prominently ridged scutellum, and with its large body, the insect of *crassior* is readily distinguished from *carolina,* altho the two insects resemble each other in color. In western Virginia and probably in the western Carolinas, it may be expected that *crassior* hybridizes with *carolina. Crassior* is distinctly a southern insect, chiefly of the lowlands. Thruout the southern mountains variety *litigans* represents the species. At several localities we found both *crassior* and *litigans* occurring on the same trees as distinct insects or, on occasion, hybridizing. The galls of *crassior* are larger and always clustered while those of *litigans* occur singly on the leaves, so the two may be readily separated in the field. The galls of *crassior* are distorted from their normally spherical shape by the pressure of the adjacent galls in the cluster, and they are consequently drawn out to a conical base. The single galls of *litigans* have rounded or even flattened bases. From the same area occupied by *crassior,* on *Q. stellata,* we have variety *albicolens* from *Q. alba.*

Cynips mellea variety **albicolens**, new variety agamic form

Figures 56, 396

FEMALE.—Body almost entirely black, with almost no rufous on the head; the antennae dark brown, only the first two segments rufous; mesonotum more or less smooth, rather sparsely punctate and hairy;

anterior parallel and lateral lines rather broad but obscure; median groove quite evident posteriorly, distinctly longer than broad, quite rugose, with a more or less distinct median ridge; foveal groove broad, entirely rugose at bottom; abdomen entirely black, quite elongate, the second segment rather tongue-shaped, legs rufous and rufo-brown; wings long, about 1.30 times the body length; the areolet of moderate size or larger; cloud on the first abscissa of the radius small; tip of the radius sharply bent toward the tip of the wing; large but not very robust insects 2.8 to 4.0 mm. in length. Figure 396.

GALL.—Typical for the species, averaging about 6.0 mm. in diameter, larger than any other variety of the species; well rounded (occurring singly?); on the leaves of *Quercus alba.*

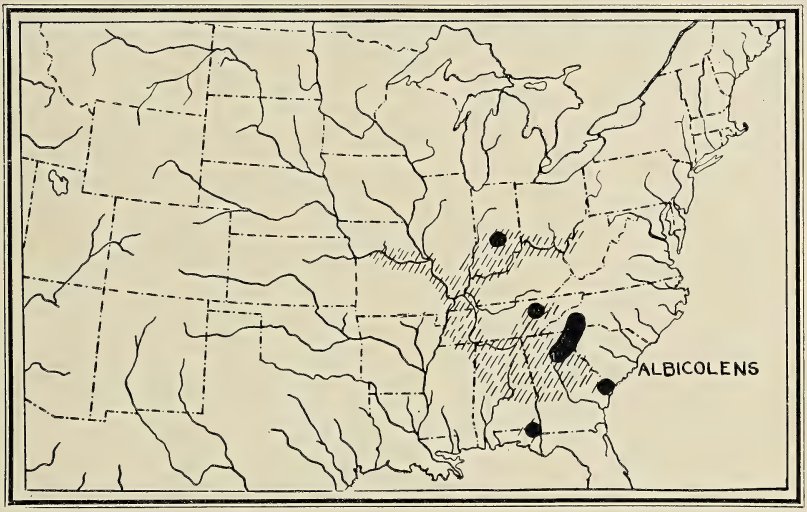


FIG. 56. SOUTHERN VARIETY OF C. MELLEA ON Q. ALBA
Possible extension of known range shown by shading.

RANGE.—Indiana: Nashville (Kinsey coll.).
Tennessee: Oakdale (Kinsey coll.).
North Carolina: Hendersonville (Kinsey coll.).
South Carolina: Hardeeville (hybrid, Kinsey coll.). Travellers Rest (galls, Kinsey coll.).
Georgia: Madison (types, Kinsey coll.). Hartwell (Kinsey coll.).
Florida: Campbellton (hybrids, Kinsey coll.).

Probably confined to *Q. alba,* thruout central Georgia and Alabama, in the Tennessee River Valley in Tennessee, in other states in areas immediately adjacent to this area, and thru the Ohio River Valley into southern Indiana. Figure 56.

TYPES.—7 females and 35 galls. Holotype and paratype females in the Kinsey collection. Paratype galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, and the U.S.

National Museum. Labelled Madison, Georgia; galls November 2, 1928; insects April 10, 1929; *Q. alba;* Kinsey collector.

Of all the long-winged varieties of *mellea*, this is the most distinct. Its black body makes it superficially resemble *unica* and *litigans*, but in spite of the color the insect is no closer to these than to other varieties of the species. *Albicolens* occurs in much the same area of Georgia, Alabama, and the Tennessee and lower Ohio River Valleys occupied by the post oak variety *crassior*, but *albicolens* is strictly a white oak *(Q. alba)* species. This host isolation is especially interesting because several of the other varieties of the species, occurring in other faunal areas, fail to make any distinction between *Q. alba* and *Q. stellata*.

Our insects of this variety were bred on March 20 and April 10.

Cynips (Acraspis) conica, new species agamic form

Figures 57, 288-289, 336, 361, 404

FEMALE.—In color bright brownish rufous, darker rufo-piceous in places; antennae bright brownish rufous basally; thorax of normal size; the entire mesonotum finely rugose; parapsidal grooves very narrow, continuous tho indefinite anteriorly; anterior parallel lines evident but almost wholly punctate; lateral lines indistinct, not smooth but evident; median groove absent; scutellum quite rugose, rather flattened, the foveal groove rather deep, rugose at bottom; mesopleuron finely rugoso-punctate, a smooth and punctate area centrally; abdomen bright brown and red-rufous, darker in places especially dorso-posteriorly, of normal size, rather elongate, the second segment tongue-shaped, covering two-thirds of the whole abdomen; legs entirely light brownish rufous; wings long, about 1.30 times the body length; the infuscation on the first abscissa of the radius of moderate size; the areolet quite large and elongate on the cubitus; the expanded tip of the second abscissa of moderate size, the cubital cell without clouds or spots; length 2.5 to 3.0 mm. Figures 361, 404.

GALL.—A smooth, pointed, conical leaf gall with the broadened base bearing spiny projections. Regularly or irregularly conical, up to 7.0 mm. in height; or the tip rather sharply pointed (and sometimes curved); the base sometimes flaring, its edge entire or bearing up to 6 short, blunt, spiny projections; the base up to 6.0 mm. in diameter; entirely smooth and glossy, or in part finely puberulent, light pinkish brown, with a violet tinge due to the puberulence. Internally filled with

a rather compact mass of branched fibers, the larval cell rounded, up to 2.5 mm. in diameter, located very near the base of the gall. Attached by a slightly projecting point on the middle of the broad base, on the veins of the under surfaces of leaves of *Quercus grisea.* Figures 288-289, 336.

RANGE.—Arizona: Globe.

Probably confined to a limited area including the country between Globe and Phoenix, Arizona. Figure 57.

TYPES.—3 females and many galls. Holotype and paratype insects and galls in the Kinsey collection; galls at the Museum of Comparative Zoölogy, the U.S. National Museum, and the American Museum. Labelled Globe, Arizona; January 20, 1920; *Q. grisea;* Kinsey collector.

When the type material was collected at Globe on January 20 (in 1920), most of the galls showed the holes thru which the adult gall makers had previously emerged; but three adults emerged a few days after that. Emergence thus occurs in mid-January, even tho the winter season is rather severe in the mountains near Globe. No further life-history data are available, but judging from the related species of the genus, the gall may be expected to appear early in the summer.

Other varieties of *conica* may be expected in Arizona, New Mexico, and West Texas, and further south in Mexico.

Cynips (Acraspis) nubila Bassett
agamic forms

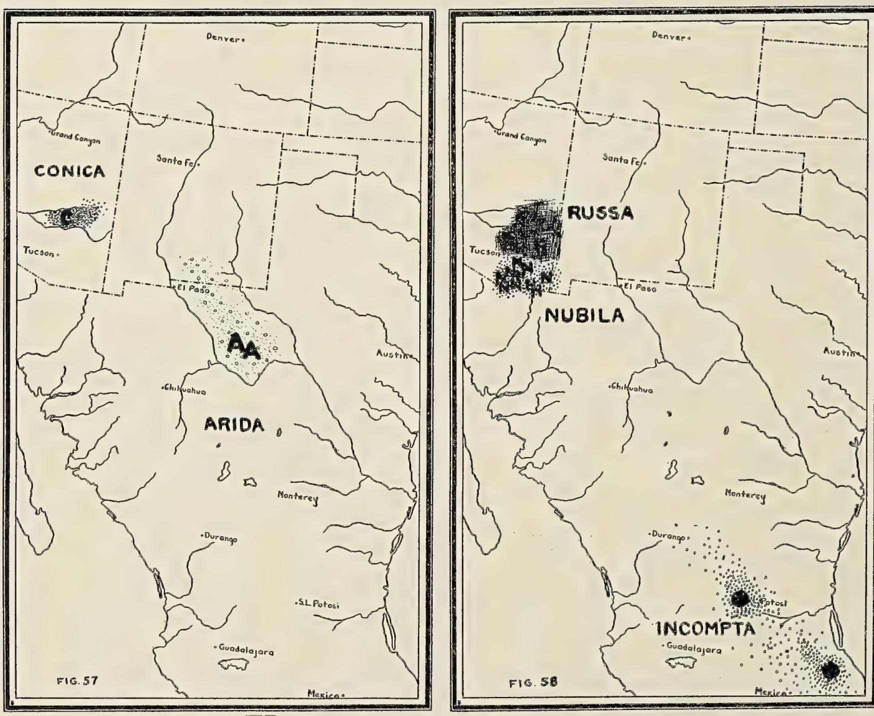
FEMALE.—Thorax of normal size; the mesonotum punctate to rugoso-punctate; parapsidal grooves continuous or obscure anteriorly; anterior parallel lines wholly punctate, poorly defined; lateral lines smooth, naked, broad; median groove sometimes shallowly indicated at the scutellum; scutellum rugose, very slightly raised along the mid-line; the foveal depression finely, irregularly rugose at bottom; mesopleuron mostly smooth and shining but with a fine, shallow punctation; abdomen of normal size, mostly naked or entirely but sparsely hairy; wings long, about 1.30 times the body length, with a complete venation; infuscation on the first abscissa of the radius extending one-fifth to more than one-third the length of the radial cell; areolet large to very large; a rather broad infuscation on the second inter-cubital vein; with two irregular, more or less fused, smoky patches lying side by side and filling a large part of the apical third of the cubital cell; a faint cloud at the break in the anal vein; length 2.5 to 4.0 mm.

GALL.—A mass of coarse hairs, containing a spherical, hard core. Monothalamous, the core averaging 4.0 to 7.0 mm., the entire gall averaging 10.0 to 15.0 mm., compacted clusters of several galls measuring

up to 24.0 mm. in diameter. The central core strictly spherical except where drawn out basally at the point of attachment; the surface of the core crystalline, very rough, scurfy, covered with short, straw-colored, crystalline hairs among which are the close-set, long, fine, hair-like spines which form the tangled, woolly covering of the gall, these spines up to 8.0 mm. in length, unbranched, wavy. The central core hard, crystalline, brittle, with an outer wall fully 1.0 mm. in thickness; all of the rest of the core (up to 5.0 mm. in diameter) is hollow, the inner walls being rough, irregular, without any other larval cell. Occurring singly or, more often, in clusters of two to five galls, the clusters usually more or less hemispherical but sometimes more elongate when containing several galls; attached to the mid-veins, on the under surfaces of the leaves of *Quercus arizonica, Q. oblongifolia, Q. Toumeyi, Q. reticulata, Q. glaucophylla*(?), and probably other related oaks.

RANGE.—Known from Arizona and central Mexico. Probably widespread in Mexico, and to be expected in southwestern New Mexico. Figure 58.

The gall of this species is one of the most attractive in the genus *Cynips*. The tangled mass of brilliantly colored, hair-like spines covering the spherical core marks the gall at some



FIGS. 57-58. CYNIPS CONICA, C. ARIDA, C. NUBILA VARIETIES

distance in the field. In collecting in January (1920) in the Santa Rita Mountains of southern Arizona, I camped at four thousand feet among trees on which *nubila* galls were common. A mountain storm had banked these evergreen oaks with wet snow, offering a background against which the wine-purple galls appeared too fantastic to be real anywhere but in the enchanted lands of our Southwest.

The galls of the Arizona varieties probably appear early in the summer; they are full-grown by September, and the adults probably mature in another month or so. The insects, however, do not emerge until late in December or in January, during a season of cold weather and snow. Perhaps the more southern, Mexican variety, *incompta,* has a different life history.

While *nubila* is common in Arizona south of Globe, it has not yet been recorded from north of there or from New Mexico. It must be very rare in these latter regions if it occurs in them at all.

While the hairy gall of this species appears superficially different enough from the galls of most *Cynips,* it is nothing but a *villosa* gall with the spines much lengthened. The spines are inserted on the surfaces of the two in the same way, in two varieties of *nubila* they are enlarged basally, quite as they are in *villosa,* and in both species they are surrounded basally by peculiar, short, crystalline hairs. The resemblances are so striking that, once having seen them, one wonders why they are not apparent at first glance.

Cynips nubila variety **nubila** Bassett
agamic form

Figures 58, 397

Cynips Q. nubila Bassett, 1881, Canad. Ent. 13: 56.

Dryophanta nubila Mayr, 1881, Genera gallenbew. Cynipiden: 36. Bassett, 1882, Amer. Nat. 16: 246. Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296, 304. Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 370, 371, pl. 12, fig. 3. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 179. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Dalla Torre, 1893, Cat. Hymen. 2: 53. Kieffer, 1901, André Hymén. d'Europe 7 (1): 621. Mayr, 1902, Verh. zoo.-bot. Ges. Wien 52: 290. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 53. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 344, pl. 16 fig. 3. Thompson, 1915, Amer. Ins. Galls: 20, 38. Felt, 1918, N.Y. Mus. Bull. 200: 114, fig. 68 (3).

Andricus nubila Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128.
Diplolepis quercus-nubila Dalla Torre and Kieffer, 1910, Das Tierreich 24: 358, 815.
Cynips nubila Cresson, 1923, Trans. Amer. Ent. Soc. 48: 200.
Diplolepis nubila Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 27.

FEMALE.—Generally rich, dark rufous, darker to rufo-piceous in places, almost black on the thorax anteriorly between the parapsidal grooves and about the lateral lines, the abdomen rufo-piceous, the legs mostly rufous but darker to rufo-piceous on the coxae; mesonotum posteriorly punctate with a distinctly coriaceous surface between the punctations, anteriorly rugoso-punctate; parapsidal grooves quite obscure anteriorly; scutellum rather roughly rugose; mesopleuron smooth and shining between the punctations but everywhere finely, shallowly punctate; the sides of all the segments of the abdomen sparsely hairy, the second segment with heavier patches of hair antero-laterally; infuscation on the first abscissa of the radius prominent, extending more than a third the length of the radial cell, part of the infuscation almost as dark as the vein itself; the enlargement at the tip of the second abscissa of considerable size, extending parallel to the margin of the wing and entirely to one side (toward the tip of the wing) from the radius; areolet large to remarkably large; smoky patches in the cubital cell very large, filling a large part of the apical third of the cell, usually fused; a large and heavy insect, 3.5 to 4.0 mm. in length. Figure 397.

GALL.—The core straw to dirty brown in color, the hair-like spines whitish at base but for the most part rich wine-purple, fading to purplish pink; the bases of the spines somewhat swollen; on leaves of *Quercus arizonica* and *Q. oblongifolia* (and *Q. Toumeyi?*).

RANGE.—Arizona: Santa Rita Mountains (*Q. arizonica, Q. oblongifolia,* Kinsey coll.; also acc. Weld 1926). Courtland and Fort Huachuca (*Q. arizonica,* Kinsey coll.). Whetstone (galls, *Q. arizonica,* Kinsey coll.). Ramsay Canyon in Huachuca Mountains (*Q. arizonica* and galls on *Q. oblongifolia,* acc. Weld 1926). Patagonia (*Q. arizonica, Q. Toumeyi,* and galls on *Q. oblongifolia,* acc. Weld 1926). Tumacacori Mountains, Bisbee, and Chiricahua Mountains (*Q. arizonica,* acc. Weld 1926). Mule Pass Mountains (E. T. Cox, types). Nogales (galls, *Q. oblongifolia,* acc. Weld 1926.)

Known only from Arizona south of Tucson, probably in the mountains of southwestern New Mexico. Figure 58.

TYPES.—3 females and galls in the Philadelphia Academy. 1 female in the U.S. National Museum. From the Mule Pass Mountains, Arizona; *Q. arizonica*(?); November, 1879; E. T. Cox collector.

The present re-descriptions are based on the holotype and all the paratypes, and on material from other localities in southern Arizona.

The type material of *nubila* was collected in November. Weld collected galls in December and bred adults on January 2 and 13, and February 6 and 10. From the galls I collected

between January 6 and 16 (in 1920), I found some of the adults emerging, while others emerged later in January.

Weld collected this species on *Quercus Toumeyi* at Patagonia, Arizona. He says that these insects average smaller than those from *Q. arizonica*, but he believes they represent the same variety.

The original Bassett description of *nubila* states that the areolet is "very small", a curious error—as examination of the type material proves it to be.

Variety *nubila* is replaced north of Tucson by a variety with a russet-colored gall. The insects of the two seem indistinguishable. For a discussion, see variety *russa*.

Cynips nubila variety **russa,** new variety
agamic form

Figures 58, 325, 368, 398

Diplolepis nubila err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 27, 34.

Diplolepis quercus-nubila err. det. Houard, 1928, Marcellia 24: 102, fig. 10-12.

FEMALE.—Indistinguishable from that of variety *nubila (q.v.)*; mesonotum posteriorly finely coriaceous between the punctations, parapsidal grooves obscure anteriorly; the sides of all the abdominal segments hairy; areolet very large. Figures 368, 398.

GALL.—The core straw to dirty brown in color, the hair-like spines for the most part whitish or yellowish, the tips colored dull apricot or yellowish russet, fading to flesh color; the bases of the spines somewhat swollen; on leaves of *Quercus arizonica* and *Q. oblongifolia*. Figure 325.

RANGE.—Arizona: Sabino Trail in Santa Catalina Mountains (*Q. arizonica, Q. oblongifolia,* Kinsey coll.; also *Q. diversicolor* acc. Weld 1926). Oracle (*Q. arizonica,* Kinsey coll., types; also acc. Weld 1926). Safford and Globe (*Q. arizonica,* Kinsey coll.).

Apparently confined to Arizona north of Tucson. Figure 58.

TYPES.—8 females and 22 clusters of galls. Holotype and paratype females and galls in the Kinsey collection. Paratype galls in the American Museum of Natural History, the Museum of Comparative Zoology, and the U.S. National Museum. Labelled Oracle, Arizona; January 11, 1920; *Q. arizonica;* Kinsey collector.

Weld collected galls of this variety in December and bred adults December 31, January 3, 4, 10, 12, 14, 16, 22, 23, and 24, and February 6. The forest insect collection of the U. S.

National Museum has material bred March 30 (in 1916). From the galls I collected early in January (1920) few of the adults had yet emerged, but after the middle of the month few adults were left in the galls.

If there are differences between the insects of *russa* and variety *nubila,* the individual variation is great enough to obscure the varietal distinctions. The galls of the two insects are also very similar, having the same form and structure but differing markedly in the coloring of the hair-like, spiny coatings. All of the galls from north of Tucson are rich russet in color, representing variety *russa;* the galls from south of Tucson are of a fine, wine-purple color, representing variety *nubila.* I am establishing *russa* on the color of the gall and the distinctive geographic range. A geographic segregation that proves at all constant should be recognized, and it seems warranted to provide a name for data which may be considered a unit in its biologic significance.

There are numerous other instances in this genus of practical identities of the insects bred from distinct galls. *Cynips echinus echinus* and *Cynips echinus douglasii; Cynips echinus schulthessae* and *C. echinus vicina; Cynips mirabilis* and *C. maculosa; Cynips multipunctata* and *C. heldae,* are pairs of nearly or closely identical insects inhabiting distinct types of galls. If the color of a *nubila* gall is controlled by the insect, as most galls would justify us in believing, then constantly distinct colors may be considered expressions of the inherited make-up of the cynipids. It may be suggested, of course, that *russa* galls are faded specimens of *nubila,* but *nubila* fades purplish white instead of russet. There have been available for my examination many galls of both varieties collected at various dates between November and the middle of February, and none of them gives any evidence that the color will change from purple to russet with age or advancement of the season. That the hosts are not responsible for the color difference is evidenced by the occurrence of both varieties on both *Q. arizonica* and *Q. oblongifolia.* Weld also records galls on *Q. reticulata* (= *Q. diversicolor* Trelease) in the Santa Catalina Mountains. I covered considerable territory in the Santa Catalina Mountains, finding the russet gall common there, and I cannot believe that I overlooked the wine-purple galls of *nubila* which were, on the other hand, common in the Santa Rita Mountains. Two of the 40 clusters of galls

I collected in the Santa Rita Mountains were yellow-brown, but even they were not the russet color of the more northern material.

The numerous mountain ranges in Arizona between Globe and the Mexican boundary are for the most part of limited extent and peculiarly isolated from each other by much lower deserts. While only a few miles may separate any two of the ranges, the deserts that lie between are ecologically so different from the higher elevations that they give many instances among both plants and animals of the isolation of distinct races or varieties. It is consequently not surprising to find that *russa* occurs in the Santa Catalina, while *nubila* occurs in the Whetstone Mountains (southwest of Whetstone station) about forty miles away; and since the Rincon Mountains will probably be found to have the northern variety—for the Rincons are nearly continuous with the Santa Catalinas—*russa* may be found to extend to within 15 or 20 miles of *nubila* in the Whetstones. One who has seen this desert-and-mountain country will, however, not be surprised to find additions to the list of plants and animals which find the deserts barriers to ready migration and hybridization.

Cynips nubila variety **incompta** (Kinsey)

agamic form

Figures 58, 299-300, 399

Andricus incomptus Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 306, figs. 17, 18. Houard, 1928, Marcellia 24: 72, figs. 143-145.

Diplolepis nubila err. syn. Weld, 1926 (in part), Proc. U. S. Nat. Mus. 68 (10): 27.

——[no name] Kinsey, 1926, Introd. Biol. fig. 277b.

FEMALE.—Almost uniformly light yellowish or brownish rufous, only slightly darker in places; mesonotum posteriorly punctate with smooth surfaces between the punctations, anteriorly rugoso-punctate; parapsidal grooves distinctly continuous, as distinct and broad anteriorly as posteriorly, rather sharply divergent anteriorly; scutellum only finely rugose; mesopleuron more smooth and shining, almost naked dorsally; abdomen hairy only on the second segment antero-laterally; infuscation on the first abscissa of the radius limited, not heavy, not extending more than a fifth of the length of the radial cell; enlargement at the tip of the second abscissa of the radius of only moderate size, more or less symmetrical about the tip of the vein; areolet moderately large; smoky patches in the cubital cell of moderate size only,

rather well separated; a small insect, 2.5 to 3.2 mm. in length. Figure 399.

GALL.—The core yellowish to rich reddish russet in color, the spines for the most part yellowish white, the tips colored rich golden yellow; the bases of the spines not at all swollen; on leaves of what at least resembles *Quercus reticulata* and *Q. glaucophylla.* Figures 299-300.

RANGE.—Mexico: San Luis Potosi (Palmer coll., types). Sierra de Zacopoaxtla (L. Diguet acc. Houard 1928).

Probably confined to an area in more central Mexico. Figure 58.

TYPES.—2 females and 28 galls. Holotype female and galls in the Museum of Comparative Zoölogy; paratype female and galls in the Kinsey collection; galls in the Philadelphia Academy. From San Luis Potosi, Mexico; September, 1878; on *Q. reticulata*(?); Edward Palmer collector. The adults were cut from the galls in 1918.

The present re-descriptions are made from the paratype insect and numerous type galls compared with my original descriptions.

The galls collected in September were fully grown and the insects far enough along at that time to have matured after collecting. It is not impossible that the more southern varieties of *Cynips* have only one generation a year, as is certainly true of several of the southern California Cynipidae, and in such a case the growth of *incompta* may begin much earlier, tho proceeding more slowly, than is the case with the Arizona varieties of *nubila.*

The leaves with the type material would now appear to represent *Quercus reticulata* (as restricted in Trelease's monograph of the American Oaks). I also have galls of what seems to be *incompta* collected by Bonansea in Mexico (without definite locality) and sent me by Prof. Trotter of Portici, Italy. This material appears to be on *Q. glaucophylla,* but I cannot be certain of determinations based on so few leaves of such difficult Mexican oaks.

Soon after the original publication of *incompta,* Beutenmüller, who had never seen the type material, wrote me that it was a synonym of *nubila.* Weld has recently published this synonomy with the following comments: "The writer has examined both [types], comparing one directly with a Bassett type of *nubila.* As the galls were collected in September it is the writer's idea that at that time the nutritive layer had not been all used up and the larva had vitality to transform into an undersized adult but not enough to chew its way out of the

hard gall. Never having been exposed to light and open air it is much paler than flies that emerge normally. Had it darkened up normally the two adjacent spots near the apex of the wing might have become connected into one double one as is the case in *nubila,* a series of which shows considerable difference in the amount of fusion that has taken place in the spots, due either to fluctuating variation or to the length of time that has elapsed or amount of exposure to light since emergence from the gall. If a *nubila* wing were bleached somewhat it would present the condition seen in *incomptus*."

My own distinction of *nubila* and *incompta* is herein embodied in comparative descriptions, an examination of which should show that it will take more than bleaching to turn *nubila* into *incompta.* While admitting the inadequacies of two specimens cut from old galls, and while admitting that fresh material may be larger and darker than the types, I cannot believe that the surface of the mesonotum, the length of the parapsidal grooves, the surfaces of the mesopleuron, the hairy areas on the abdomen, the size of the areolet, or other such distinctive characters are abnormal in the type material of *incompta.* The galls of *incompta* and *nubila,* while similar, are certainly distinct in color and, more significantly, in the shapes of the bases of the spines.

The types of *incompta* come from a locality removed from the known range of *nubila* by eight hundred miles of Mexican desert and mountain country. This alone should have invited careful comparisons before it was concluded that the two names are synonyms.

Cynips (Acraspis) villosa (Gillette)

agamic forms

FEMALE.—Thorax of normal size or much reduced in size; the mesonotum rugoso-punctate anteriorly, smoother posteriorly (in long-winged varieties) or entirely rugoso-punctate and very hairy (in short-winged varieties); parapsidal grooves continuous or discontinuous, nearly obliterated in short-winged varieties; anterior parallel lines wholly punctate, poorly defined; lateral lines smooth, naked, broad, or all lines obliterated in short-winged varieties; median groove absent; scutellum more or less rugose, rather flattened, a bit depressed on the median line, the foveal depression smooth to finely rugose at bottom; mesopleuron mostly punctate and hairy, with a more naked area centrally; abdomen

of normal size or enlarged, largely naked (long-winged forms) or largely hairy (short-winged forms); wings long, with a complete venation—or reduced and with a modified venation; if the wings are long, the first abscissa of the radius has a prominent infuscation, the areolet is present with its bounding veins more or less infuscated, the tip of the second abscissa of the radius is very large and triangulate, and there are two large, smoky brown patches side by side in the apical half of the cubital cell; length 2.3 to 4.0 mm.

GALL.—A moderate-sized, spherical, bristly gall or a spiny gall resembling a sea urchin. Up to 14.0 mm., averaging nearer 7.0 mm. in diameter. The body of the gall strictly spherical except where flattened

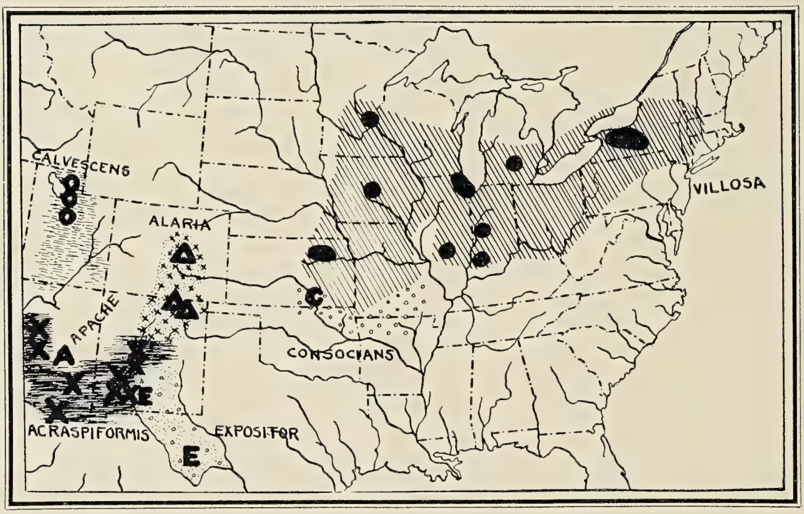


FIG. 59. VARIETIES OF CYNIPS VILLOSA
Illustrating geographic isolation of related insects.

a bit basally; entirely, closely covered with long, stiff, stout spines 2.5 mm. long, the tips of these spines pointed, drawn out, sometimes forming slender, irregular, bristle- or hair-like projections, the bases abruptly swollen, ovoid, up to 0.5 mm. in diameter, the sides of the bases flattened by contact with the adjacent spines; the spines brittle, in two varieties easily detached, soon worn off of old galls, exposing dense rosettes of short, crystalline hairs which encircle the base of each spine; the surface of the gall crystalline, minutely roughened; the gall appearing white with a bright rose tinge when young, becoming rich reddish buff to brown with age. The shell of the mature gall up to 0.8 mm. thick, compact-crystalline; all of the rest of the interior empty, without a distinct larval cell. Attached to the mid-veins, on the under surfaces of leaves of the Rocky Mountain white oaks, *Quercus macrocarpa,* and the southwestern evergreen white oaks.

RANGE.—In the Southwestern United States from Arizona and Utah into West Texas and southern Colorado, eastward in the Middle West to Indiana and New York State; also to be expected southward into Mexico. Figure 59.

The very attractive galls of this species are to be found over a wide area in the Southwest, but they are rarely common. They appear early in the summer, full-sized galls developing by late August. The adults mature sometime in the fall but do not emerge until November, December, or early January.

One of the varieties, *apache*, has shortened wings, but its gall is indistinguishable from that of the long-winged *acraspiformis*. The long-winged variety from West Texas, namely *expositor*, produces a distinctive gall which more closely resembles the work of the short-winged variety *alaria*. Thus the unity of this interesting assemblage of short-winged and long-winged insects is assured. The contiguous distributional areas of the short-winged and long-winged insects in the Southwest further justify our opinion that these superficially diverse forms are no more than geographic segregates of a single ancestral stock.

Cynips villosa is closely related to *C. nubila.* A study of the comparative descriptions of the two shows surprisingly few differences outside of the coloration, the wider pubescence of the abdomen, and the more elongate hypopygial spine of *nubila.* The two clouded patches are distinctly separate in the wings of *acraspiformis*, while they are more or less fused in *nubila.* With the insects so similar, it is interesting to find that the galls are also similar, the stiffer spines of *acraspiformis* being replaced by long, flexuous, hair-like spines in *nubila.*

Cynips villosa variety **acraspiformis** (Weld) agamic form

Figures 59, 304, 330, 400

Diplolepis acraspiformis Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 14, fig. 30.

FEMALE.—Entire body, including the antennae and legs (except the coxae) piceous to black, light brownish piceous in places; head rather narrower than the thorax, evenly shagreened; thorax quite large and robust, about half again as long as wide; parapsidal grooves more or less complete tho indefinite anteriorly; scutellum moderately rugose,

no smoother anteriorly; the foveal groove of moderate width; sparingly rugose at bottom and more or less indefinitely divided into foveae; mesopleuron mostly smooth and finely, sparingly, evenly punctate; abdomen naked except for the patches latero-basally, strongly produced, the second segment extending three-quarters of the way to the posterior tip of the abdomen; wings long, about 1.30 times the body length; the infuscation on the first abscissa of the radius light brown, rather limited in extent; areolet large; length 2.7 to 3.6 mm. Figure 400.

GALL.—Rosy red to rosy brown in color; up to 10.0 mm., averaging nearer 7.5 mm. in diameter, the spines up to 2.5 mm. in length, stiff, straight, stout, the bases up to 0.5 mm. in diameter, tapering rather gradually; the whole suggesting a sea urchin; on the leaves of *Quercus undulata, Q. Toumeyi, Q. grisea,* and *Q. arizonica.* Figures 304, 330.

RANGE.—New Mexico: Blue Canyon west of Socorro (types, Weld coll.). Nogal Canyon south of Socorro (acc. Weld 1926). Kingston (Kinsey coll.). Hillsboro (galls, Kinsey coll.). Burro Mountains (galls, acc. Weld 1926).

Arizona: Ashfork (galls, acc. Weld 1926). Prescott (Kinsey coll.; also W. W. Jones in Kinsey coll.). Safford (Kinsey coll.). Hackberry and Patagonia (acc. Weld 1926).

Probably confined to the southern two-thirds of Arizona and New Mexico (and adjacent Mexico). Figure 59.

TYPES.—Holotype and 4 paratype females and 8 galls in the U.S. National Museum, Cat. No. 27184. Paratype female and galls at the American Museum of Natural History, one female and galls in the Field Museum, and in Stanford University. A gall in the Kinsey collection. The holotype and some paratypes from Blue Canyon near Socorro, New Mexico; November 7; *Q. undulata;* Weld collector. Other paratypes from Hackberry, Arizona, *Q. undulata,* Weld collector; still others from Patagonia, Arizona; *Q. Toumeyi;* Weld collector.

The present re-descriptions are based on the holotype and paratypes in the National, Field, and American Museums.

This variety has a wide range over the southern two-thirds of New Mexico and Arizona, and shows no segregation into distinct varieties on *Q. undulata, Q. grisea, Q. arizonica,* or *Q. Toumeyi.*

Weld cut live adults out of galls collected near Socorro, New Mexico, on November 7 (in 1921), and had others emerge December 31 and January 13. One adult from Patagonia, Arizona, emerged December 13. From galls which I collected in Arizona at Safford on January 18 and at Prescott on January 23 (in 1920) all but the last adults had already emerged. The galls Mr. W. W. Jones collected in March (1924) were empty.

The original spelling of the name of this variety should have been *acraspidiformis,* if we are to follow the declension of the Latin *aspis, aspidis;* but as the Rules stand, we accept the published spelling.

Cynips villosa variety **expositor,** new variety
agamic form

Figures 59, 301-302, 326, 340, 362, 401

FEMALE.—Mostly bright rufous, even on the antennae and the legs including the coxae; the mesonotum darker to black anteriorly between the parapsidal grooves and about the lateral lines, the abdomen rufous and in part rufous brown; head fully as wide as the thorax, finely, irregularly shagreened or coriaceous; thorax of moderate size, rather slender, three-quarters again as long as wide; parapsidal grooves more or less complete altho indefinite anteriorly; scutellum only finely rugose, smoother and much depressed anteriorly, with a very broad, rather deep foveal groove which is only very finely rugose at bottom and without a trace of a division into foveae; mesopleuron mostly smooth, in places closely punctate, a more smooth and naked area centrally; abdomen naked except for the patches latero-basally, not strongly produced dorsally, the second segment rather tongue-shaped, extending three-quarters of the way to the posterior tip of the abdomen; the wings long, about 1.30 times the body length; the infuscation on the first abscissa of the radius large, extending a third the length of the radial cell and almost as dark as the vein itself; areolet of moderate size or a little larger; length 3.2 to 3.5 mm. Figures 340, 362, 401.

GALL.—Mature galls yellow-brown in color, up to 8.5 mm., averaging nearer 6.0 mm. in diameter; the spines up to 4.0 mm. in length, rather flexuous, slender, the bases up to 0.4 mm. in diameter, but the spine very slender right down to this base; the whole appearing as a tangled mass of coarse hairs; on leaves of *Quercus grisea* and *Q. arizonica.* Figures 301-302, 326.

RANGE.—Texas: Alpine (types; *Q. grisea,* Kinsey coll.).

New Mexico: Soledad Canyon in Organ Mts. (galls, *Q. arizonica;* L. H. Bridewell in Kinsey coll.).

Probably restricted to the desert mountain areas of West Texas and immediately adjacent areas in New Mexico. Figure 59.

TYPES.—4 females and 8 galls. Holotype and paratype females and galls in the Kinsey collection. Galls in the American Museum of Natural History and the U.S. National Museum. Labelled Alpine, Texas; December 14, 1919; *Q. grisea;* Kinsey collector.

The galls collected in the Organ Mts., New Mexico, on August 23 (1927) were too young to breed. The last adults

were emerging from the galls which I collected at Alpine, Texas, on December 14 (1919).

This insect is distinct from its widespread New Mexico and Arizona relatives, altho clearly related to them, and the gall is also readily distinguishable. Here is one more instance of the fact that the West Texas and adjacent New Mexico cynipid fauna does not extend further north or west in New Mexico.

Cynips villosa variety **apache,** new variety

agamic form

Figures 59, 303, 363, 402

FEMALE.—Head (including the antennae), thorax, and legs (including the coxae) rich rufous to brownish rufous, the abdomen rufopiceous; head slightly wider than the thorax, finely coriaceous to shagreened; thorax of moderate size, half again as long as wide; parapsidal grooves hardly traceable more than three-quarters of the way to the pronotum; scutellum finely rugose, finely rugose anteriorly; the foveal groove of moderate width, shallow, smooth at bottom, with a suggestion of a division into foveae; mesopleuron mostly smooth and finely, evenly punctate; abdomen naked except for the patches laterobasally, well-produced, the second segment extending more than two-thirds of the way to the posterior tip of the abdomen; the wings reduced to about 0.70 of the body in length, not extending beyond the tip of the abdomen, the venation consequently modified; length 2.3 mm. Figures 363, 402.

GALL.—Indistinguishable from that of variety *acraspiformis (q.v.),* the spines stiff, straight, stout, the whole suggesting a sea urchin; on leaves of *Quercus grisea* and *Q. arizonica.* Figure 303.

RANGE.—Arizona: Globe (types, Kinsey coll.). Fish Creek on Apache Trail (gall, Kinsey coll.).

Probably confined to a limited area east of Phoenix, Arizona. Figure 59.

TYPES.—2 females and many galls. Holotype and paratype females and galls in the Kinsey collection; galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, and the U.S. National Museum. Labelled Globe, Arizona; January 20, 1920; *Q. grisea* (holotype) and *Q. arizonica* (paratype); Kinsey collector.

The holotype female seems to be a mature adult (unfortunately laden with glue in the mounting); the other female is small and not fully pigmented but otherwise agreeing with the holotype. The two specimens came from different oaks. The wings of both are shorter than those of *Cynips dugèsi*

brevipennata, tho not as short as those of a *Philonix.* The hypopygial spine is a little smaller than in the other two varieties of the species.

The Apache Trail country of Arizona, the region in which *apache* is to be found, seems to have a cynipid fauna largely distinct from that of adjacent areas both north and south of Globe and Phoenix, but I have no data on the extent of this area.

Cynips villosa variety **alaria** (Weld)

agamic form

Figures 59, 341, 364, 407

Acraspis alaria Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 13, 14.

FEMALE.—Close to the varieties *calvescens* and *villosa.* Generally dark rufo-piceous, only the thorax (especially the scutellum) and the legs with some brighter rufous; head distinctly wider than the thorax, very finely, irregularly rugose; the thorax much reduced, half again as long as wide; parapsidal grooves very fine or nearly obliterated, extending at most half way to the pronotum; scutellum rather smooth with a not heavy punctation, anteriorly depressed to form the undivided, poorly defined foveal groove; the ridge between the scutellum and the rest of the mesonotum only very poorly indicated; mesopleuron mostly punctate and very hairy; abdomen enlarged, rather elongate, entirely hairy on the sides of segments 2 to 5, not at all produced dorsally, the second segment not covering more than half the whole abdomen; the wings much reduced but relatively broad, about 0.32 of the body in length, reaching at most to the mid-point of the second abdominal segment, the venation much reduced, only the subcosta and cross-veins well defined; length 2.5 to 3.7 mm. Figures 341, 364, 407.

GALL.—Mature gall straw-yellow in color, up to 11.0 mm. in diameter, the spines up to 2.5 mm. in length, rather flexuous, slender, the whole gall appearing as a mass of coarse and tangled hairs; on the leaves of *Quercus Gambelii, Q. submollis,* and probably related oaks.

RANGE.—Colorado: Colorado Springs (Pollock in U.S. Nat. Mus.; types).

New Mexico: Raton Pass near Raton (F. Cogshall in Kinsey coll.). 28 miles east of Raton (C. Schwachheim in Kinsey coll.).

Probably restricted to a Rocky Mountain area in southern Colorado and northern New Mexico, probably not to be expected south of the Sandia Mountains in New Mexico. Figure 59.

TYPES.—13 females and galls. Holotype and 10 paratype females and 2 galls in the U.S. National Museum, Hopkins No. 10773x; a paratype female in the Kinsey collection. From Colorado Springs, Colorado;

galls November 4, 1918; insects November 11, 1919, and January 15, 1919; *Q. Gambelii;* J. H. Pollock collector.

The present re-description is made from all of the types, compared with my material from northern New Mexico.

This is the southern Rocky Mountain variety of the species, a short-winged insect replaced in the southern two-thirds of New Mexico and Arizona by the long-winged *acraspiformis,* but in Utah by the short-winged *calvescens.* The material collected by Frederick Cogshall near Raton, New Mexico, was full-sized late in July (1926), and the larva was large enough to complete development in spite of a prolonged drying to which its gall was subjected before reaching our laboratory. This insect emerged out-of-doors at Bloomington, Indiana, on December 18 (1926). The galls of the type material were collected at Colorado Springs on November 4 (1918), one adult emerging on November 11 while others were found alive in the breeding cage on the following January 15.

Cynips villosa variety **calvescens,** new variety agamic form

Figures 59, 307-308, 366, 408

FEMALE.—Close to the varieties *alaria* and *villosa.* Generally bright rufous with much dark rufous and piceous black; the head distinctly wider than the thorax, very finely, irregularly rugose; the thorax much reduced, half again as long as wide; the parapsidal grooves very fine or nearly obliterated, extending at most half way to the pronotum; scutellum rather smooth with a not heavy punctation, anteriorly depressed to form the undivided, poorly defined foveal groove; the ridge between the scutellum and the rest of the mesonotum only very poorly indicated; mesopleuron punctate and very hairy; abdomen enlarged, rather elongate, largely hairy but naked in many spots on the second segment, naked on the basal half of the exposed portion of the third and fourth segments, and naked over a distinctly wide area on the whole abdomen dorsally; the second segment covering a half to two-thirds of the whole abdomen; the wings much reduced but relatively broad, distinctly longer than in either of the varieties *alaria* or *villosa,* averaging 0.34 of the body in length, with a fairly complete venation in the basal half of the wing; length 2.8 to 4.0 mm., averaging nearer 3.3 mm. Figures 366, 408.

GALL.—Mature gall straw-yellow in color, up to 14.0 mm. in diameter, the spines up to 2.5 mm. in length, rather flexuous, slender, the whole gall appearing as a mass of coarse and tangled hairs; on the leaves of *Quercus utahensis* (and related oaks?). Figures 307-308.

RANGE.—Utah: Bountiful (types; B. and H. J. Pack in Kinsey coll.). Farmington, Santaquin, and Layton (B. and H. J. Pack in Kinsey coll.).

Probably restricted to an area in more northeastern Utah. Figure 59.

TYPES.—149 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls at the American Museum of Natural History, the U.S. National Museum, the Museum of Comparative Zoölogy, the Utah Agricultural College, the Stanford University museum, the California Academy of Science, and the Field Museum. Labelled Bountiful, Utah; galls September 10, 1927; females December 5 and 23, 1927; *Q. utahensis;* B. and H. J. Pack collectors.

This is an apparently common insect in the mountains of northeastern Utah. Its closest relatives are *alaria,* which occurs in southern Colorado and northern New Mexico east of the Continental Divide, and the variety *villosa,* which ranges from Kansas into New York State. *Calvescens* is immediately distinguished by the large, naked area on the abdomen, the more eastern insects having the sides of their abdomens entirely hairy. The name *calvescens* (becoming bald) emphasizes the striking appearance of the new variety. This Utah insect also has a distinctly longer wing and averages shorter in body length than either of the other varieties.

The Cynipidae of Utah, as far as I have studied them, are never the same as those of Colorado, and the present species serves to illustrate how distinct these faunas may be.

We are indebted to Dr. H. J. Pack and his daughter, Bessie Pack, for all the material we have of this insect. The galls collected early in September (1927) seemed fully mature. Out-of-doors at Bloomington, Indiana, I bred 66 adults by December 5, another 76 by December 13, and another 9 at some later date (all in 1927).

Cynips villosa variety **villosa** (Gillette)
agamic form

Figures 59, 365, 409

Acraspis villosus Gillette, 1888, Mich. Board Agric. Rpt. 27: 474. Gillette, 1889, Psyche 5: 218, 221, fig. 4. Gillette, 1890, Proc. Iowa Acad. Sci. 1887-1889: 55. Gillette, 1891, Bull. Ill. Lab. Nat. Hist. 3: 203. Gillette, 1892, Proc. Iowa Acad. Sci. 1 (2): 113. Cook, 1910, Mich. Geol. and Biol. Surv. Publ. 1: 29. Thompson, 1915, Amer. Ins. Galls: 16, 36.

Acraspis villosa Dalla Torre, 1893, Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 410, 639, 816, 832. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 13. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 58. Weld in Leonard, 1928, Ins. N.Y.: 971.
Philonix villosus Felt, 1906, Ins. Aff. Pk. and Woodland Trees 2: 713.
Philonix villosa Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 249, pl. 43 figs. 8, 9. Felt, 1918, N.Y. Mus. Bull. 200: 94, fig. 89 (8, 9).

FEMALE.—Close to the varieties *alaria* and *calvescens*, distinguished from variety *consocians* only in being more slender and generally lighter in color. Head and thorax bright rufous with some black, the abdomen bright rufous with much piceous to black on the posterior half; head distinctly wider than the thorax, very finely, irregularly rugose; the thorax much reduced, rather slender, two-thirds again as long as wide; the parapsidal grooves nearly obliterated; scutellum rather smooth with a not heavy punctation, anteriorly depressed to form the undivided, poorly defined foveal groove; the ridge between the scutellum and the rest of the mesonotum only very poorly indicated; mesopleuron punctate and very hairy; abdomen enlarged, rather elongate, entirely hairy on the sides of segments 2 to 5, not at all produced dorsally, the second segment covering a half to two-thirds of the whole abdomen; the wings much reduced but relatively broad, 0.30 of the body in length, reaching at most one-quarter of the way along the second abdominal segment, with only the subcosta and basalis defined; length 3.2 to 4.0 mm. Figures 365, 409.

GALL.—Mature gall straw-yellow, staining browner in color; up to 13.0 mm. in diameter, the spines up to 2.0 mm. in length, rather flexuous, slender; the whole gall appearing as a dense mass of coarse and tangled hairs; on the leaves of *Quercus macrocarpa*.

RANGE.—New York: Medina (acc. Weld 1926). Seneca Lake (Dudley in Cornell Univ., acc. Weld 1926). Ithaca (acc. Weld 1928).

Michigan: Agricultural College (acc. Gillette 1889).

Indiana: Crawfordsville (E. C. Stout in Kinsey coll.). Rogers in Pike County (gall, Kinsey coll.).

Illinois: Evanston and Winnetka (acc. Weld 1926). Pana (Kinsey coll.).

Minnesota: Minneapolis (J. S. Benner in Kinsey coll.).

Iowa: Ames (types, Gillette coll.).

Kansas: Manhattan (thru C. V. Riley; in U.S. Nat. Mus.). Riley County (Marlatt in U.S. Nat. Mus., Kans. Agric. Coll., and Kinsey coll.).

Probably restricted to the range of *Q. macrocarpa* in the more northern Middle West, from northeastern Kansas into New York State. Figure 59.

TYPES.—8 females and galls. Holotype and 4 paratype females and galls in the U.S. National Museum; 3 paratype females in the Philadelphia Academy; type galls in the Museum of Comparative Zoöl-

ogy. From Ames, Iowa; galls October 20, females October 29 (without year); *Q. macrocarpa;* C. P. Gillette collector.

The present re-descriptions are based on all of this type material compared with my Indiana, Minnesota, and Kansas material.

INQUILINE.—*Synergus villosus* Gillette (acc. Gillette 1890).

This is the most eastern representative and the first-known variety of the species. It is usually not a common insect and it is not well represented in our collections. Superficially the gall appears as a tangled mass of coarse hairs, but the slender tips break off on handling and expose the broader bases of the spines, leaving the gall more like the agamic *Cynips gemmula* in appearance. The gall of *villosa* is hardly distinguishable from the galls of *consocians* and of *alaria,* from southern Kansas and the southern Rockies, respectively. *Villosa* insects are more rufous, with shorter wings than *alaria* and with a more slender thorax than *consocians.*

Gillette recorded these galls as appearing in the mid-summer. Weld found pupae (in galls from Medina, N. Y.) on August 24 and September 4, and cut active adults out of galls early in October and (from northern Illinois material) on November 1. On October 23 (1926) the insect had already emerged from a gall I collected in southern Indiana. Gillette's galls collected on October 20 gave adults on October 29. My material from Minneapolis emerged on November 10, from central Indiana on November 20, and from central Illinois on December 8. The Marlatt material from Riley County, Kansas, emerged in January (one specimen is labelled September!).

Cynips villosa variety **consocians,** new variety agamic form

Figures 59, 367, 410

FEMALE.—Very close to variety *villosa* from which *consocians* is distinguished by being more robust and darker. Head and thorax dark rufous with some black, the abdomen bright to dark rufous with much piceous or black on the posterior half; head distinctly wider than the thorax, very finely, irregularly rugose; the thorax much reduced in size but relatively robust, half again as long as wide; the parapsidal grooves nearly obliterated; scutellum rather smooth with a not heavy punctation, anteriorly depressed to form the undivided, poorly defined foveal groove; the ridge between the scutellum and the rest of the mesonotum only very poorly indicated; mesopleuron punctate and very hairy; abdomen enlarged, rather elongate, entirely hairy on the sides

of segments 2 to 5, not at all produced dorsally, the second segment covering a half to two-thirds of the whole abdomen; the wings much reduced but relatively broad, 0.30 of the body in length, reaching at most one-quarter of the way along the second abdominal segment, only the subcosta and basalis defined; length 2.7 to 4.3 mm., averaging about 3.8 mm. Figures 367, 410.

GALL.—Mature gall straw-yellow, staining browner in color; up to 13.0 mm. in diameter, the spines up to 2.0 mm. in length, rather flexuous, slender; the whole gall appearing as a dense mass of coarse and tangled hairs; on the leaves of *Quercus macrocarpa.*

RANGE.—Kansas: Winfield (types, R. Voris in Kinsey coll.).
Either an Ozark variety extending westward to eastern Kansas, or a Texas variety extending northward to southern Kansas; the material insufficient to allow more precise prediction. Figure 59.

TYPES.—117 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the U.S. National Museum, the American, Field, Stanford, and California Academy Museums, and the Museum of Comparative Zoölogy. Labelled Winfield, Kansas; galls September 7, 1927; insects November 20 and December 5 and 17, 1927; *Q. macrocarpa;* R. Voris collector.

This is either the Ozark or the eastern Texas variety of the species. In addition to the type series from southeastern Kansas, I have some material without data other than the record that I collected it in 1919-20. It was therefore probably collected in the southern United States not further north than northern Texas or southern Mississippi. This suggests that *consocians* is an eastern Texas variety finding its northern limit in Kansas. The galls are identical with variety *villosa,* and the insects of *consocians* are very close to *villosa* and *alaria.* These three varieties would hardly be distinguished except for their distinct ranges and the fact that among these sub-apterous Cynipidae the simplification of structure has proceeded so far that one may use only a part of the characters available among long-winged insects. The type series of *consocians* is a fine collection large enough to insure constancy in the few characters on which the variety is established.

Galls from the type locality were full-sized and contained very small larvae early in August (1927). By early September the larvae had grown enough to be suitable for collection for breeding. Adults emerged from these galls on November 20 and December 5 and 17 (1927).

Cynips (Acraspis) gemmula Bassett

bisexual and agamic forms

AGAMIC FEMALE.—Thorax much reduced and narrowed; the mesonotum puncto-rugose, sparsely pubescent; parapsidal grooves fine, more or less incomplete; anterior parallel lines and median groove entirely absent; lateral lines nearly or entirely absent; scutellum only very finely rugose and hairy, moderately narrow and elongate, with a distinctly pointed but not very sharp tip, not flattened, not depressed anteriorly, with a very narrow and poorly defined foveal groove; the ridge separating the scutellum from the rest of the mesonotum fine and indefinite; mesopleuron entirely punctate and hairy; abdomen enlarged, only moderately elongate, not produced dorsally, usually swollen cylindric, the second segment covering half of the whole surface; the abdomen naked except for limited patches of hair on the second segment latero-anteriorly and for a few stray hairs near the ventral margins of the third and fourth segments; wings much reduced, very narrow and elongate, about 0.27 of the body in length, with hardly a trace of venation; length 2.5 to 3.5 mm.

BISEXUAL FEMALE AND MALE.—Known for only a single variety, so see the description for variety *gemmula* bisexual form *gemmula.*

GALLS OF AGAMIC FORMS.—Moderately large, spherical, roughly faceted, with short spines. Usually monothalamous, often with two or three cells in variety *cruenta;* the normal galls strictly spherical, up to 17.0 mm. in diameter; the surfaces closely set with numerous, bluntly cone-shaped projections which usually terminate in short, stiff, and blunt spines; the cones plus the spines usually not over 1.5 mm. in length; the young galls light greenish or yellow tinged with red, the older galls light buff yellow to brown and blackish. Internally compact crystalline, the walls very thick, the entire gall consequently solid except for the centrally placed larval cell which is up to 2.2 mm. in diameter and without a distinct cell wall. Attached to either the upper or under surfaces, usually to the mid-rib but sometimes on lateral veins, on leaves of chestnut oaks (known from *Q. prinoides, Q. Michauxii, Q. Muhlenbergii*).

GALL OF BISEXUAL FORMS.—A thin-walled, egg-shaped cell, occurring singly in the buds of the chestnut oaks. Known for only a single variety, so see the description for variety *gemmula* bisexual form *gemmula.*

RANGE.—Apparently confined to the chestnut oaks in the United States east of the Rocky Mountains; known from Massachusetts to Georgia, and Kansas. Figures 60-62.

The best-known form of this species is *prinoides,* the agamic generation of variety *gemmula.* As with other species of *Acraspis* in the eastern United States, the young galls of the

agamic forms may be expected in June (June 8, 1927, in southeastern Kansas). Emergence is recorded for November, December, and January. Oviposition has not been observed, but the bisexual insect, *Cynips gemmula* Bassett, is here identified with *prinoides* on purely taxonomic evidence (for which see the discussion under form *gemmula*). This bisexual insect and its bud galls are close to the bisexual form of *C. pezomachoides* variety *erinacei,* but the bisexual *gemmula* may be known by its more shining mesonotum and continuous parapsidal grooves and by its host.

The insects of our present species show so many points of relation to the insects of *pezomachoides* that I have debated the propriety of considering them varieties of one species. But in *pezomachoides* the abdomen is much compressed, in *gemmula* it is usually swollen cylindric, and the wing stubs are longer and narrower in *gemmula.* The agamic galls of the present species resemble galls of the more eastern varieties of *Cynips villosa* more closely than galls of *pezomachoides.* The present species is, as far as known, confined to chestnut oaks, from which hosts *pezomachoides* is strictly excluded.

Gemmula is known from four varieties, differing chiefly in color and size. Variety *gemmula,* of the northeastern quarter of the country, seems to be of hybrid origin with the Ozark *fuscata* and the northern *suspecta* as the parents. Variety *cruenta* is a very distinct insect of Georgia and the adjacent southeast, ranging as far north as the southern tip of Illinois.

Cynips gemmula variety **cruenta,** new variety

agamic form

Figures 60, 310, 371, 411

FEMALE.—Head largely bright, rich rufous, the entire thorax including the pronotum, mesonotum, and mesopleuron, and the legs brownish rufous; the abdomen rufous to rufo-piceous, more distinctly rufous over much of the basal half; the abdomen more compressed than in other varieties of *gemmula,* tho still not as compressed as in *pezomachoides;* large insects, 3.5 to 4.5 mm., averaging nearer 4.0 mm. in length. Figures 371, 411.

GALL.—Up to 18.0 mm. in diameter, either monothalamous or (often) with two or (occasionally) three cells; the gall always spherical; on *Quercus Michauxii* and the southeastern variety of *Q. Prinus.* Figure 310.

RANGE.—Georgia: Irwinton (Kinsey coll.).

Illinois: America (types, Kinsey coll.).

Indiana: Spencer (hybrid with *fuscata;* Kinsey coll.).

Kansas: Riley County (incl. hybrids with *fuscata;* Marlatt in Kans. Agric. Coll. and Kinsey coll.).

Probably restricted to a Southeastern area including most of Georgia, Alabama, the Tennessee Valley in Tennessee, and the Mississippi Basin including the lower Ohio and Missouri drainage areas. Figure 60.

TYPES.—39 females, many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the U.S. National Museum, the American Museum of Natural History, and the Museum of Comparative Zoölogy. Labelled America, Illinois; galls October 16, 1927; *Q. Michauxii;* Kinsey collector.

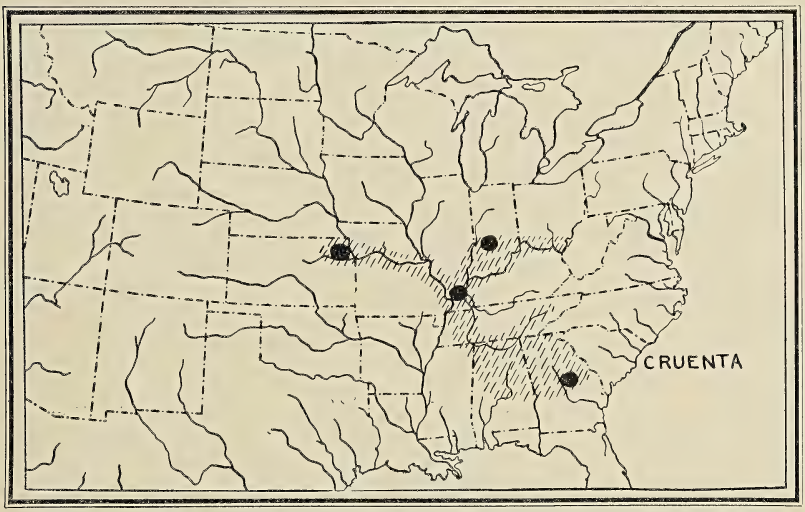


FIG. 60. SOUTHERN VARIETY OF CYNIPS GEMMULA
Possible extension of known range shown by shading.

The type material was collected on October 16, at which time all the galls had fallen from the leaves and were rapidly disintegrating in the wet ground. This type collection was made from a single, isolated tree of *Quercus Michauxii,* on the broadest and wettest part of the Ohio River flood plain, within a half mile of the river and about 13 miles from the point of union of the Ohio and Mississippi Rivers. The material is identical with that we have from central Georgia and with part of the material from Riley County in northeastern Kansas. The rest of the Riley County material is intermediate between *cruenta* and *fuscata.* The Illinois, Indiana, and Kansas

records undoubtedly represent extreme northern localities for an insect which centers chiefly in the southeastern quarter of the country just north of the Gulf Coast.

Our Georgia material emerged on November 19 and December 6 (1928). The Riley County material is recorded as emergent in January (with one specimen labelled November).

The insects of *cruenta* are perfectly distinct in color, size, and form from the other varieties of this species. *Cruenta* shows a rather compressed abdomen which approaches that of *pezomachoides*, lending further emphasis to the close affinities of the two species. Our present insect, however, still shows that it belongs to the chestnut oak stock, for some of the individuals of the type series have more cylindric abdomens than any specimens of *pezomachoides* I have ever seen.

Cynips gemmula variety **fuscata,** new variety

agamic form

Figures 61, 309, 370, 412

FEMALE.—Head entirely dark rufous to piceo-rufous; the entire thorax and the legs rich, dark rufous; the mesonotum rougher and more hairy than in variety *gemmula;* the abdomen swollen cylindric, entirely black; medium sized insects, 3.2 to 3.8 mm. in length. Figures 370, 412.

GALL.—Averaging nearer 8.0 mm. altho up to 14.0 mm. in diameter; always monothalamous; on *Quercus Michauxii* and *Q. Mühlenbergii.* Figure 309.

RANGE.—Indiana: Aurora, Bloomington, Bedford, and Spencer (Kinsey coll.). Benham (gall, G. F. Hyatt in Kinsey coll.).

Illinois: Bloomfield in Johnson County (gall, Kinsey coll.).

Kentucky: Cleveland (Kinsey coll.).

Kansas: Riley County (Marlatt in Kans. Agric. Coll. and Kinsey coll.). Winfield (R. Voris; types, in Kinsey coll.). Arkansas City and Silverdale (galls, R. Voris in Kinsey coll.). Cedarville (R. Voris in Kinsey coll.).

Missouri: Springfield (R. Voris in Kinsey coll.).

Probably confined to the chestnut oaks in a more southern area of the Middle West, from southern Indiana to eastern Kansas, with the range centering in the Ozark areas. Figure 61.

TYPES.—10 adults and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the U.S. National Museum and the American Museum of Natural History.

Labelled Winfield, Kansas; galls June 8 and 28, August 22, and September 7, 1927; adults January 4 and 6, 1928; *Q. Mühlenbergii,* R. Voris collector.

This insect is poorly distinct from the agamic form of variety *gemmula.* Since *gemmula* appears to be of hybrid origin with *fuscata* as one of the parents, every intergrade between these two insects is to be expected on the northern edge of the range of *fuscata,* and *fuscata* will appear as a segregate from the hybrid over most of the range of *gemmula.* To judge from our rather limited material, *fuscata* is a fairly constant insect over the good sized geographic area from southern Indiana to southeastern Kansas.

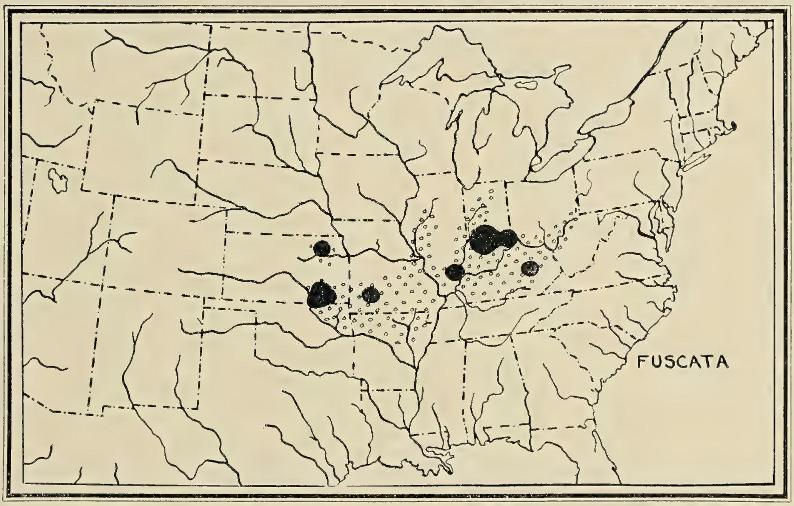


FIG. 61. OZARK VARIETY OF CYNIPS GEMMULA
Possible extension of known range shown by shading.

Dr. Voris found galls of this variety as early as June 8 in southeastern Kansas. By June 28 the balls were full size, but it was not until late in August that the insects were large enough to be bred in our window boxes. Our emergence dates for *fuscata* are December 1, 6, 8, 10, 16, and 18, and January 1, 4, and 6. In general the later emergence was for the more southwestern localities.

The alternate, bisexual generation of this variety should nearly agree, in both insect and gall characters, with the bisexual form described for variety *gemmula.*

Cynips gemmula variety **suspecta,** new variety agamic form

Figures 62, 369, 413

FEMALE.—Head entirely black; the thorax dull rufo-piceous (either lighter or darker), the mesonotum only microscopically roughened and the whole thorax nearly naked of hairs; the abdomen swollen cylindric, entirely black, naked except for a very few hairs on the second segment basally; small insects 1.5 to 2.7 mm. in length. Figures 369, 413.

GALL.—Not distinct from that of variety *gemmula;* monothalamous; on leaves of *Quercus Michauxii* (and probably other chestnut oaks).

RANGE.—Indiana: Bloomington (types, C. M. Kinsey coll.).
Probably ranging from southern Indiana to southern Michigan, as far north as chestnut oaks occur. Figure 62.

TYPES.—24 females. Galls not distinguished from agamic galls of *Cynips gemmula gemmula* from the same locality. Holotype and paratype females in the Kinsey collection. Paratype females in the U.S. National Museum and the American Museum of Natural History. Labelled Bloomington, Indiana; galls September 27, October 19, and November 7, 1928; insects December 1, 8, 10, and 18, 1928; *Q. Michauxii;* C. M. Kinsey collector.

Among the insects of the hybrid variety *gemmula* collected at Bloomington in southern Indiana, we have the very small, dark, nearly naked specimens which we are taking for the types of *suspecta.* In the discussion under *gemmula (q. v.)* we have suggested that these may represent segregates from the hybrid variety *gemmula.* Extreme individuals of *suspecta* are so distinct from typical *gemmula* that they demand taxonomic recognition, whether we ultimately find them to correspond with the northern variety which was one parent of *gemmula* (with variety *fuscata* as the other parent) or whether we have to take *suspecta* as a Mendelian form. For further discussion, see the account of *gemmula.*

The type insects of *suspecta* emeregd on December 1, 8, 10, and 18 (all in 1928).

Cynips gemmula variety **gemmula** (= *C. gemmula suspecta* x *fuscata?*) agamic form **prinoides** Beutenmüller

Figures 62, 327, 344, 346, 414

Cynips (?) prinoides Beutenmüller, 1892, Bull. Amer. Mus. Nat. Hist. 4: 257, pl. 11 fig. 6. Felt, 1912, N.Y. Mus. Bull. 155: 130.

Philonix prinoides Ashmead in Smith, 1900, Cat. Ins. N.J.: 548. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 249, pl. 43 figs. 6, 7. Viereck, 1916, Hymen. Conn.: 382. Felt, 1918, N.Y. Mus. Bull. 200: 94, fig. 89 (6, 7). Metcalf and Flint, 1928, Destructive and Useful Insects: 9, fig. 4 I.

Cynips prinoides Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 60. Beutenmüller, 1904, Amer. Mus. Journ. 4: 103, fig. 32. Felt, 1906, Ins. Aff. Pk. and Woodl. Trees 2: 619, 627. Stebbins, 1910, Springfield Mus. Nat. Hist. Bull. 2: 31, fig. 59. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 442, 812, 835, figs. 188, 189. Lutz, 1918, Fieldbook Ins.: 462, pl. 97 fig. 2.

Philonyx prinoides Beutenmüller in Smith, 1910, Ins. N.J.: 598.

(?) Cynips prinoides Thompson, 1915, Amer. Ins. Galls: 15, 28.

Acraspis prinoides Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 14. Weld in Leonard, 1928, Ins. N.Y.: 971.

FEMALE.—The head largely black, with considerable rufous about the compound eyes; most of the thorax a rich, not dark rufous; the mesonotum smoother and less hairy than in *fuscata;* the abdomen swollen cylindric, black; rather small insects, 2.3 to 3.5 mm., averaging under 3.0 mm. in length. Figures 344, 346, 414.

GALL.—Averaging nearer 8.0 mm., altho up to 11.0 mm. in diameter; always monothalamous; on leaves of *Quercus prinoides, Q. Michauxii, Q. Mühlenbergii,* and possibly other chestnut oaks. Figure 327.

RANGE.—Massachusetts: Springfield (gall, acc. Stebbins 1910). Eastern part (bisex. form, Thompson in Bost. Soc. coll.).

Connecticut: Waterbury (bisex. form, Bassett coll.).

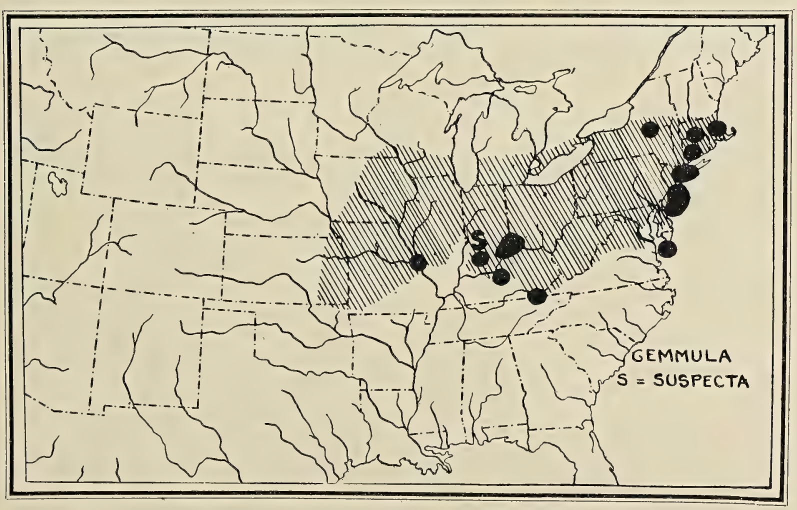


FIG. 62. NORTHEASTERN VARIETIES OF CYNIPS GEMMULA
Possible extension of known range shown by shading.

New York: Oriskany Falls (galls, J. A. Douglass acc. Felt 1912). Vicinity of New York City (acc. Beutenmüller 1904). Staten Island (acc. Weld 1928).

New Jersey: Lakehurst (Beutenmüller and W. T. Davis in Kinsey coll.). Toms River (Beutenmüller, types). Richland (Kinsey coll.).

Virginia: Cape Charles (Kinsey coll.).

Ohio: Cincinnati (gall, Braun in Amer. Mus.).

Indiana: Bloomington (C. M. Kinsey coll.). Benham (G. F. Hyatt in Kinsey coll.). Aurora (Kinsey coll.).

Kentucky: Lebanon (Kinsey coll.).

Tennessee: Tazewell (gall, Kinsey coll.).

Missouri: Ranken (Kinsey coll.).

Occurring in the northeastern United States from Massachusetts to southern Indiana and Missouri, south in the mountains to Kentucky and Tennessee, confined to areas in which chestnut oaks are found. Figure 62.

TYPES.—One female, several galls in the American Museum of Natural History. From Toms River, New Jersey; galls August and September; *Q. prinoides;* Beutenmüller collector.

The variety originally described from one female cut from a gall; additional insect material in the American Museum and other collections cannot be considered types.

The present re-descriptions are made from the holotype compared with our material from the Coastal Plain and amplified by our Middle-Western material.

This is the common variety of the species over the northeastern quarter of the United States. I find no appreciable difference between the northern Coastal Plain material on *Q. prinoides* (the source of the type) and our Middle-Western series of the insect on *Q. Michauxii* and *Q. Mühlenbergii.* In this failure to differentiate a Coastal Plain variety *gemmula* is matched by *Cynips fulvicollis.*

In common with all the other *Cynips* of this part of the country, *gemmula* shows an extreme degree of individual variation that may indicate a hybrid origin of the variety, possibly dating from the Pleistocene glaciation which projected northern varieties into the ranges of southern varieties and which ultimately, upon the glacial retreat, left a great territory where the hybrid individuals developed into hybrid populations deserving taxonomic recognition (see pp. 55 to 60). The Ozark variety *fuscata* would appear to be the southern parent of *gemmula,* for *gemmula* intergrades into *fuscata* in southern Indiana (and probably elsewhere). Unlike the other species of *Cynips* involved in this area, the northern parent of *gem-*

mula is not known from any pure population in the north, possibly because most of the chestnut oaks, which are the hosts of our insect, do not range as far north as other white oaks. If they did extend further north in the former day, there may have been a northern parent of *gemmula* which does not now survive. Nevertheless, in the fine series of *gemmula* which we have from Bloomington, in southern Indiana, there are a few individuals that are much smaller and darker, with smoother and more naked body surfaces. Since these are the very characters which distinguish the most northern varieties of *Cynips pezomachoides, C. fulvicollis, C. hirta, C. folii, C. divisa,* and *C. longiventris,* it is possible that these small insects of *gemmula* are Mendelian segregates from the hybrid stock, and that these represent the northern parent of *gemmula.* It is, on the other hand, possible that these small individuals represent local mutants. We have described them as variety *suspecta.* Out of the 606 insects we have bred from Bloomington material, we find 23 (= 3.8%) have this small and dark form, 22 (= 3.6%) seem characteristic *fuscata,* and the remaining 92.6% are the variable hybrid series which is *gemmula.*

The galls of the agamic *gemmula* are to be found late in August (acc. Beutenmüller) but they probably appear much earlier than this—perhaps late in June as with other species of *Cynips.* The galls were of full size at Lakehurst, New Jersey, on September 14 (1904, W. T. Davis in Kinsey coll.), and at Bloomington, Indiana, early in September (1928). The insects had not yet emerged from the galls I collected at Richland, New Jersey, on October 13, at Cape Charles, Virginia, on October 17 (both in 1919), and at Ranken, Missouri, on October 29 (in 1926). Material in the American Museum records unemerged adults in the galls on an October 26. Our emergence dates for this insect are December 1, 2, 4, 6, 8, 10, 16, 18, and 21.

Cynips gemmula variety **gemmula**

bisexual form **gemmula** Bassett

Figures 62, 305, 306, 335, 342, 343, 345, 405

Cynips gemula Bassett, 1881, Canad. Ent. 13: 104. Packard, 1881, U.S. Ent. Comm. Bull. 7: 57. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 199.

Dryophanta gemmula Mayr, 1881, Gen. gallenbew. Cynip.: 35, 36. Bassett, 1882, Amer. Nat. 16: 246. Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296, 304. Mayr, 1886, Verh. zoo.-bot. Ges. Wien 36: 371. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 179. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Dalla Torre, 1893, Cat. Hymen. 2: 52. Kieffer, 1901, André Hymén. d'Europe 7(1): 621. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 25. Beutenmüller in Smith, 1910, Ins. N.J.: 599.

Dryophanta gemula Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 131. Felt, 1906, Ins. Aff. Pk. and Woodl. Trees 2:713. Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 358, pl. 16 figs. 11, 12. Thompson, 1915, Amer. Ins. Galls: 11, 37. Felt, 1918, N.Y. Mus. Bull. 200: 75, fig. 68 (11, 12).

Diplolepis gemmula Dalla Torre and Kieffer, 1910, Das Tierreich 24: 359, 807, 822, 835.

[*Diplolepis gemula* err. det. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 26; and Weld in Leonard, 1928, Ins. N.Y.: 969, = *C. pezomachoides erinacei* form *bicolens* and some undescribed forms.]

FEMALE.—Head, thorax, and abdomen piceous to black, the latter uniformly piceous black; the antennae rich brown with the first two segments yellowish, the legs amber yellow except on the hind coxae which are brownish basally; mesonotum mostly smooth and naked, very shining, very scantily hairy and sparingly roughened just lateral to and anteriorly about the parapsidal grooves; the grooves entirely distinct to the pronotum; the anterior parallel and lateral lines and median groove practically absent; scutellum entirely, rather finely rugose except in the narrow foveal groove, the ridge separating the scutellum from the rest of the mesonotum fine but distinct; the mesopleuron almost entirely smooth, naked, and shining; areolet of moderate size or larger; all of the cells clear except for a trace of a blotch at the base and two blotches nearer the apex of the cubital cell; length 1.5 to 2.0 mm. Figures 342, 345, 405.

MALE.—Differing from the bisexual female as described for the genus. With the basal segments of the antennae light brownish rufous, the whole anterior half of the scutellum smooth and shining, the blotches absent from the cubital cell. Figure 343.

GALL.—A small, thin-walled, elongate, egg-shaped cell in a bud. Monothalamous, about 2.0 to 3.0 mm. long, regular in form, nearly egg-shaped but somewhat more elongate, pointed apically, truncate at base; microscopically roughened; older galls dark brown to blackish. Very thin-walled, brittle when dry, without a distinct larval cell. Singly, deep and nearly hidden in the leaf or flower buds, or at the apices of young stems or on the main stems of the staminate flowers and surrounded by a few deformed bracts; on *Quercus prinoides*. Figures 305, 306, 335.

RANGE.—Probably as given for the agamic form *prinoides* (fig. 62); probably restricted to an area on or near the Atlantic Coastal Plain. This bisexual form known only from:

Massachusetts: eastern part (M. T. Thompson coll. No. 166).
Connecticut: Waterbury (types, Bassett).
New Jersey: Lakehurst (acc. Beutenmüller 1911).

TYPES.—Numerous females, males, and galls. The holotype female, paratype females, males, and galls in the Philadelphia Academy; paratype females, males, and galls in the American Museum of Natural History, the U.S. National Museum, the Museum of Comparative Zoölogy, the Kinsey collection, and, presumably, in the Beutenmüller collection. From Waterbury, Connecticut; May; *Q. prinoides;* Bassett collector.

The holotype and most of the paratypes have been studied in making the present re-descriptions.

Altho not represented by many collections, the good-sized series of this insect in the Bassett and Thompson collections indicate that proper search should reveal this as a very common even if obscure form in the leaf and flower buds of the chinquapin oak, *Q. prinoides.* Bassett described the galls as fully developed when the staminate flowers of the oak are in bloom. He remarked that "When the gall happens to be in a leaf bud, it is often found at the summit of a young branch one or two inches long, so rapid is the growth of the tree at this season. . . . The insects appear in both sexes about the middle of May . . ." [at Waterbury, Connecticut]. A Bassett specimen in the American Museum is labelled as *in coitu* on May 10 (1879). Thompson found the galls late in May in eastern Massachusetts, and Beutenmüller recorded (in Smith 1910:599) galls occurring in May and June—the cells probably being empty for some time before they disappear from the dried-up flower buds.

Bassett originally spelled this name *gemula,* a feminine adjective meaning *moaning* or *complaining.* It seems evident that Bassett intended to write *gemmula,* a noun meaning a small bud. This would aptly describe the gall of this insect. Perhaps it is not certain that Article 19 of the International Rules allows an emendation of this original form as a *lapsus calami;* but perhaps we need common sense rather than rules in this case.

Gemmula is here taken to be the bisexual form alternating with the agamic *prinoides.* My reasons for this opinion are as follows:

The insect shows the generic characters of a bisexual *Cynips* as established by the life histories experimentally determined for varieties of *folii* and *divisa,* and for *erinacei.*

The insect belongs to the subgenus *Acraspis,* as evidenced by the character of the hypopygial spine, the wing-body ratio, and the blotches (even tho obscure) in the cubital cell.

The relation to an agamic *Acraspis* is further proved by the close resemblance of *gemmula* to *bicolens,* the experimentally demonstrated bisexual form of *Cynips pezomachoides erinacei.*

That *gemmula* is not also a form of *pezomachoides* is shown by the host on which it occurs, namely *Quercus prinoides,* one of the chestnut oaks. *Pezomachoides* occurs only on the true white oaks of the *Q. alba* group, and is rigidly excluded from the chestnut oaks.

Cynips hirta and *prinoides* are the only agamic forms of *Acraspis* known from the chestnut oaks, and *prinoides* is the only *Acraspis* known from *Quercus prinoides.*

Prinoides, then, seems to be the only agamic *Cynips* of which *gemmula* might be the alternate, and none of the data are in conflict with the conclusion that these two are really alternates.

Cynips (Acraspis) pezomachoides Osten Sacken
bisexual and agamic forms

AGAMIC FEMALE.—Thorax much reduced and narrowed; the mesonotum coriaceous to puncto-rugose, sparsely pubescent; parapsidal grooves fine but distinct, continuous or more often not quite continuous, in variety *echinoides* extending only a short distance from the scutellum; anterior parallel lines and median groove entirely absent; lateral lines nearly or entirely absent; scutellum rugose and hairy, narrow, elongate, with a distinctly constricted, small, and rather sharply pointed tip, anteriorly depressed but with the foveal groove poorly defined, shallow, in large part rugose at bottom; the ridge separating the scutellum from the rest of the mesonotum fine and indefinite; mesopleuron entirely punctate and hairy; abdomen enlarged, distinctly elongated, not much produced dorsally, very much compressed, the second segment covering less than half of the abdomen; the entire abdomen naked except for the patches of hairs on the second segment latero-anteriorly, with a few stray hairs near the ventral margins of the third segment; wings much reduced, from 0.14 to 0.23 of the body in length, with hardly a trace of venation; length 1.5 to 3.8 mm.

BISEXUAL FEMALE.—Known only for variety *erinacei (q.v.).* Head, thorax, and abdomen piceous to black (fading quickly in dried

material); the antennae brown, yellow basally, the legs yellow except on the hind coxae which are brownish basally; the entire mesonotum mostly smooth and naked but not shining; mesonotum in no place coriaceous or rugose; the parapsidal grooves extending two-thirds of the way to the pronotum but distinctly discontinuous anteriorly; the anterior parallel and lateral lines and median groove absent; the scutellum finely rugose and finely hairy posteriorly, smoother and naked anteriorly, with a shallow and narrow foveal groove; the ridge between the scutellum and the rest of the mesonotum fine and not always definite; the mesopleuron smooth and naked, not shining; wings normal in length, the areolet rather large; all of the cells of the wings clear; length 1.7 to 2.2 mm.

MALE.—Differing from the bisexual female as described for the genus. The antennae entirely brown, with 15 segments; the ridge separating the scutellum from the rest of the mesonotum usually discontinuous.

GALL OF AGAMIC FORMS.—Small to moderately large, spherical to ellipsoid, naked and faceted to spiny. Monothalamous or agglomerate or polythalamous with 2 to 8 cells. More nearly spherical galls usually smaller, occasionally larger, up to 7.5 mm. in diameter; these galls usually with one or at the most two cells. The polythalamous galls more ellipsoid, occasionally showing lines of fusion of two or more smaller galls; up to 20.0 mm. in length. The surfaces of the galls closely set with broad, polyhedral bodies, giving a faceted appearance, these without spiny tips or with short, spiny tips, or with long and flexuous tips, the galls in consequence varying from entirely naked to roughly faceted to densely spiny. Young galls light green and rose-tinged, the spines (if present) often brilliant purplish red; the older galls becoming straw yellow to brown and darker, the spines (if present) becoming dark purple. Internally compact crystalline; the walls thick, flexible when moist, very hard when dry; the larval cavity without a distinctive cell wall, the cavity central if single, the cavities side by side if there are two, the alignment somewhat irregular if there are more than two. Attached to the midveins or lateral veins or on the petioles; on either the upper or under sides of the leaves of the true white oaks (known from *Quercus alba, Q. bicolor,* and *Q. Gambelii*).

GALL OF BISEXUAL FORM.—Small, thin-walled, elongate egg-shaped or more compressed. Monothalamous, each gall about 2.0 to 3.0 mm. long, all but microscopically smooth, whitish, becoming brownish yellow. Thin-walled, brittle when dry, without a distinct larval cell. Singly, or occasionally with two or three cells fused together; in the buds, attached at the bases of the scales or on the apical portions of the leaf and flower buds; sometimes surrounded by a few, thread-like, aborted leaves; on the same oaks as the corresponding bisexual forms.

RANGE.—Known to extend from Maine, Ontario, and Wisconsin to Florida, Oklahoma, and Utah. Figures 63-69.

Among the most common cynipid productions of the eastern half of the United States, the agamic galls of *Cynips pezomachoides* have always attracted considerable attention. Furnishing the type of the subgenus *Acraspis,* interesting because of the wingless females of the agamic generations of all the varieties, well known in the general entomological literature because of the experimental determination of the alternate, bisexual generation of variety *erinacei,* the species has proved one of the most profitable for our present studies and offers still other points that will undoubtedly repay further investigation.

The hard and crystalline agamic galls of this species, altho matched by other species of *Acraspis,* are still curious mutations of plant tissues to find in the eastern United States. Fagan (1918:157) quotes Trimble (1892, The Tannins. Phila.) to the effect that the galls of variety *erinacei* of this species contain as much as 17.89% of tannic acid (to be compared with the 65% in the Allepo gall, *Adleria gallae-tinctoriae,* and with the 40% in our native *Disholcaspis cinerosa*—Trimble analyses).

The young galls of the agamic generation of *Cynips pezomachoides* first appear in June, reaching full development in July and August. The insects pupate in the galls early in September, probably maturing soon after that, altho the adults do not ordinarily emerge until sometime in November or December. With at least the northern varieties of the species, emergence and oviposition often occur on cold days and sometimes when the temperature is below freezing. The agamic females oviposit in the buds of the white oaks. In these buds the inconspicuous galls of the next generation are to be found in the following April or May. It was as early as 1865 that Osten Sacken, knowing of Bassett's early observations on seasonal alternation in *Neuroterus,* and believing *pezomachoides* related to the European species of *Teras,* predicated the alternation of generations in this species, stating (Proc. Ent. Soc. Phila. 4:340): "As these wingless specimens, invariably females, have always been reared in winter, may they not be dimorphous females of the winged individuals, for which we would have to look out, in such a case, in the early part of summer?" As a result of Triggerson's work (1914), this bisexual generation has now been definitely recognized for va-

riety *erinacei,* and incomplete observations on *wheeleri* suggest the same sort of life history for that variety. We may expect little modification of the data for the other varieties of the species.

Pezomachoides is known from eight varieties. All of the more eastern varieties are strictly confined to the white oak, *Q. alba,* except variety *echinoides* which occurs on *Q. bicolor* in Florida. The Colorado variety *cincturata* occurs on *Q. Gambelii.* Each of the *Q. alba* varieties is geographically delimited: the variety *wheeleri* is confined to the sub-Canadian area of the northeastern United States and the eastern mountain areas, variety *pezomachoides* occurs on the

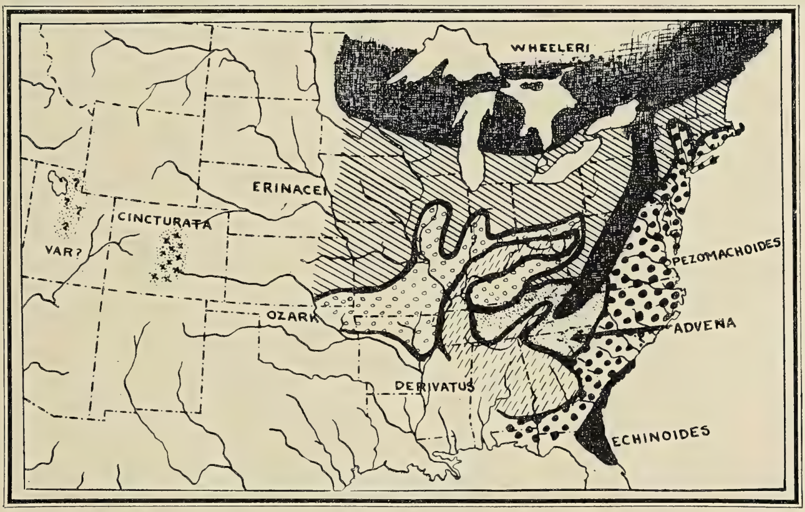


FIG. 63. SUMMARY MAP, VARIETIES OF C. PEZOMACHOIDES
Showing geographic isolation of related insects. Areas of transition and hybridization not shown. See detailed maps of each variety.

Atlantic Coastal Plain, variety *erinacei* occurs over most of the northeastern quarter of the country, variety *derivatus* occurs in Georgia and Alabama and in parts of the area adjacent to the Mississippi and Ohio Valleys, variety *ozark* centers in the Missouri Ozarks but extends over most of Kentucky and southern Indiana and parts of Illinois, and variety *advena* is typical of the Cumberland and other southeastern mountain areas.

Cynips gemmula is very close to *pezomachoides,* and was

evidently derived from the same stock, but the varieties of *gemmula* are confined to the chestnut oaks from which *pezomachoides* seems to be entirely excluded.

We have galls of what is probably an undescribed variety of *pezomachoides* from Oklahoma (in Amer. Mus. coll.), and a few undescribed insects from localities in Utah. The latter material was bred with insects of *Cynips hirta packorum,* and this suggests that the galls of the two species are not separable in Utah and that the insects of the two may even hybridize in that part of the country. The following published records seem to apply to undescribed varieties:

Acraspis pezomachoides err. det. Thompson, 1915 (*Q. bicolor,* Mass. record only), Amer. Ins. Galls: 15, 36. Err. det. Weld, 1926 (Texarkana record), Proc. U.S. Nat. Mus. 68 (10): 58.

The Rocky Mountain material of the species testifies to the origin of the group at a period before the Great Plains became so arid as to exterminate the oak forests that once connected the Southwestern and more Eastern relatives. The seven eastern American varieties of the species represent not more than three and possibly only two main stocks, a *pezomachoides-derivatus* stock, a *wheeleri* stock, and perhaps another stock which gave rise to variety *ozark. Pezomachoides,* existing in pure populations only on the rim of the Atlantic Coastal Plain today, is so widely represented in hybrids thruout the Southeast that it may be taken as very close to the original southern form of the species. From it the variety *derivatus* is a distinctive but not greatly divergent development. The northern variety *wheeleri* was undoubtedly forced southward during the Pleistocene glaciation, and as a result we have two varieties of hybrid origin. The well-known variety *erinacei,* found over most of the northeastern United States, seems to be of *wheeleri x derivatus* origin; and the variety *advena,* of the Southern Highlands, seems to be of *wheeleri x pezomachoides* origin. The data are discussed under each variety. Variety *ozark* also seems to carry *wheeleri* blood, but I have not recognized the other possible parent. Variety *echinoides,* from Florida, is too poorly known to warrant analysis.

Determinations of insects of this species are unusually difficult, in part because of the few taxonomic characters available with such reduced wings and thoraces, partly because of the great variability of the hybrid populations *erinacei* and *advena,*

in part because the *wheeleri* influence is evident in hybrid individuals thruout all but the very southern range of the species, and in part because there are broad areas of transition between varieties in most parts of the relatively uniform country in which they occur.

The matter is further complicated by the fact that the gall characters may bear no more relation to the insect characters than the color of a man's eyes bears to his height. It is true that pure populations of varieties *pezomachoides* and *derivatus* produce only naked galls, *advena* produces naked to bristly galls, and pure *wheeleri* produces only spiny galls; but galls of *erinacei* and *ozark* range from naked to spiny, and hybrid individuals everywhere produce almost every type of gall. Determinations in this group will be possible only upon comparison of large series of insects representing widespread localities. At times in our work it has seemed impossible that there was any system in the complex populations we were examining. Nevertheless, we offer our explanation of this group with some confidence because it accounts for all of the six thousand insects we have collected from nearly two hundred localities in 31 states, because an independent re-determination of all of our material verifies more than ninety-five per cent of the determinations made more than a year ago, and because the final solution is, after all, merely a repetition of the story of geographic isolation of closely related varieties, complicated in this case by a degree of individual and inter-varietal ("inter-specific") hybridization that should satisfy even the expectations of a geneticist.

The present species is the only one in true *Cynips* that ever produces a polythalamous gall, due evidently to the method of oviposition of the bisexual female which (acc. Triggerson for variety *erinacei, q. v.*) lays several eggs without changing her position on the leaf. But the generic rights of *pezomachoides* seem not so greatly endangered, for there are incompletely fused specimens that clearly show on what the polythalamous nature of the gall in this species depends.

The subgeneric position of this insect is discussed in the general treatment of *Acraspis.*

Cosens (1912, Trans. Canad. Inst. 9:342, fig. 64) interprets the histological structure of a gall of variety *erinacei* of this species as follows:

In the earliest stage examined the gall was 2. mm. in diameter. At this time none of the cell walls are sclerenchymatous and the nutritive zone is only about four narrow cells in width. Outside of this layer is a part of the parenchyma zone in which each cell contains a large crystal mass.

At a stage in which the gall is full grown but still soft, all the zones are differentiated. The epidermis is thrown into folds and is covered with a heavy cuticle [Cosens fig. 64]. This is absent in the sinuses of the folds and on the epidermis covering the spines. The parenchyma zone is gradually converted into a protective tissue of porous sclerenchyma. The thicker deposit is usually on the walls of the cells nearer the periphery of the gall. Along the outside of the nutritive zone and throughout the protective layer generally are lines of small cells almost square in outline. The walls of these cells are very thick and the lumen of each is filled with a single crystal or a mass of crystals. In galls that had become hard all the cells of the parenchyma zone were found to have sclerified. . . .

The nutritive layer of this gall differs very little in appearance from the parenchyma zone. Its cells do not contain the rich protoplasmic contents common to the nutritive zones of typical Cynipid galls.

Cook (1904, Ohio Nat. 4:142, fig. 125) gives this more brief but in some respects supplementary description of the structures of the same gall:

The galls are always developed on the mid-rib of the leaf, but contain no fibro-vascular bundles. The nutritive zone is thick and very rich in protoplasm. The protective zone is also thick and gradually merges into the parenchyma zone, which is also thick. The epidermal zone is very irregular and is covered with numerous unicellular trichomes.

The differences which the two botanists found in the amount of protoplasm in the nutritive zones might be explained as differences in the state of development of the material with which they worked. Too often micro-morphologic studies ignore the fact that tissues and cells are not static structures to be studied whenever and wherever the botanist or zoölogist cares to make his sections, but unstable living materials that change with age and under the stress of the multitudinous forces of both the external and internal environments. Both Cosens and Cook seem to have been biased in believing that all cynipid galls must have the same four layers that the earliest European students found in the first species they happened to have studied. My own interpretation of these *Acraspis* galls (see pp. 40 to 43) is that the nutritive layer is very poorly developed, the protective (sclerenchyma) zone is absent, that

the parenchyma zone is also absent, and that the hard, crystal-bearing tissue which constitutes most of the gall is a collenchyma layer not recognized by the American workers on gall histology. The epidermal layer is well described by Cook and Cosens.

Cynips pezomachoides variety **cincturata,** new variety agamic form

Figures 63, 372, 415

Cynips erinaceus err. det. Osten Sacken, 1873, Hayden Rpt. U.S. Geol. & Geog. Surv. 7: 567, No. 2.
Acraspis erinacei err. det. Ashmead, 1890, Colo. Biol. Assoc. Bull. 1: 38.
Acraspis pezomachoides err. det. Ashmead, 1890, Colo. Biol. Assoc. Bull. 1: 38.

FEMALE.—The head bright red rufous with a black area about the ocelli and down the middle of the face to the mouth; the antennae with the first two segments bright red rufous and the third to fifth segments brownish rufous; the mesonotum largely red rufous, the pronotum laterally red rufous with black edges; the mesopleuron dark rufous and black, the legs red rufous, rufo-piceous on the femora and the coxae basally; the abdomen rufo-piceous to piceous, bright rufous to rufo-piceous on the second segment basally; the mesonotum scatteringly hairy and punctate, coriaceous posteriorly, rougher anteriorly; wings averaging about 0.16 of the body in length; rather large insects 2.8 to 4.0 mm. in length. Figures 372, 415.

GALL.—Not available. Probably on *Quercus Gambelii* or its varieties.

RANGE.—Colorado (types, C. F. Baker coll.).
Probably restricted to an area in the southern Rocky Mountains. Figure 63.

TYPES.—20 adults, no galls. Holotype and paratype females in the U.S. National Museum; paratype females in the Kinsey collection. Labelled Colorado (without definite locality); number 1197; C. F. Baker collector.

This insect is easily distinguished from *erinacei*, with which the Colorado material has previously been confused. Both Osten Sacken and Ashmead recorded the occurrence of our present species in Colorado, but I have not been able to locate their specimens. The types which I am describing belong to a series that has been in the National Museum collection for some time. The galls of the type series were not located, but inasmuch as Ashmead recorded both "*pezomachoides*" and

"erinacei" from Colorado, I take it that his references apply to naked and spiny galls respectively. Perhaps both forms occur in our present variety.

Judging from the ranges of other Colorado Cynipidae, we may expect *cincturata* to be confined to an area in the southern Rocky Mountains east of the Continental Divide.

Cynips pezomachoides variety **ozark**, new variety
agamic form

Figures 64, 373, 416

Acraspis pezomachoides err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68(10) : 58.

FEMALE.—The head very dark rufous to piceous, black about the ocelli and down the middle of the face to the mouth; the antennae with the first two segments rufo-piceous to piceous-black; the entire mesonotum very dark rufous to piceous; the pronotum laterally and the mesopleuron black and very dark rufous; the legs dark rufous and piceous, nearly black basally; the abdomen largely piceous black with only a touch of rufo-piceous basally; the mesonotum fairly naked and irregularly roughened posteriorly, more hairy and finely rugose anteriorly; wings averaging about 0.14 of the body in length; moderate-sized insects 2.0 to 3.5 mm. in length. Figures 373, 416.

GALL.—Known from both naked and spiny forms; on the leaves of *Quercus alba.*

RANGE.—Ohio: Coolville, Chillicothe, and Monterey (incl. hybrids with *derivatus* and *wheeleri;* Kinsey coll.).

West Virginia: Wolf Summit and Parkersburg (incl. hybrids with *derivatus* and *wheeleri;* Kinsey coll.).

Indiana: Aurora (incl. hybrids with *wheeleri;* Kinsey coll.). Versailles and Benham (G. F. Hyatt in Kinsey coll.). Bloomington (hybrids, Kinsey coll.). Clinton, Romney, and St. John (incl. hybrids with *derivatus,* Kinsey coll.). Belmont (F. Payne in Kinsey coll.). Linton (Kinsey coll.). Charlestown (hybrids, E. W. Spieth in Kinsey coll.).

Illinois: Eddyville (incl. hybrids with *derivatus,* O. Buchanan in Kinsey coll.). America and Norris City (galls, Kinsey coll.). Greenup (Kinsey coll.). West Union, Bonnie, Olney, and Bloomfield in Johnson County (Kinsey coll.). Seneca, Sparland, and Pana (hybrids with *derivatus;* Kinsey coll.).

Kentucky: Wickliffe and Paducah, (hybrids with *derivatus* and *wheeleri,* Kinsey coll.). Whitley, Livingston and Cleveland (Kinsey coll.). Hellier (M. I. Spilman in Kinsey coll.).

Missouri: Poplar Bluff (Kinsey, galls; also acc. Weld 1926). Ironton (acc. Weld 1926). Arcadia (types). Cape Girardeau (gall, H. R. Bolen in Kinsey coll.). Annapolis (gall, E. S. Anderson in Kinsey coll.). St. Louis (hybrids, in U.S. Nat. Mus.).

Arkansas: Winslow (galls, R. Shreve in Kinsey coll.).

Probably restricted to an area extending from southern Missouri and Arkansas, eastward into West Virginia and northward into parts of Illinois and western Indiana. Figure 64.

TYPES.—173 females, many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the Museum of Comparative Zoology, the U.S. National Museum, the American Museum of Natural History, the Field Museum, the Illinois Laboratory of Natural History; the California Academy, Stanford University, the British Museum, and the Vienna Museum. Labelled Arcadia, Missouri; gall October 28, 1926; insects November 16, December 4, and December 18, 1926; *Q. alba;* Kinsey collector.

All of the insect types are from the spiny form of the gall.

This is the Ozark variety of the species, centering in southern Missouri and more northern Arkansas, found thruout most of Kentucky, and extending eastward across southern Illinois, Indiana, and Ohio into West Virginia. In the easternmost extension of the range the insect is clearly hybridized with variety *derivatus* which extends up the Ohio River Valley into Ohio and West Virginia, and in the latter state the hybrid shows further darkening with what is probably blood of the sub-Canadian and eastern mountain variety *wheeleri.* Variety *ozark* occurs in rather pure form in southern Indiana and Illinois, and its influence is evident in the darkening of the insects thruout western Indiana and the length of the Illinois River Valley in Illinois all the way to the Chicago area, but these more northern specimens show a greater size and a more rufous face and a punctate mesonotum which would appear to be due to hybridization with variety *derivatus.* The best indi-

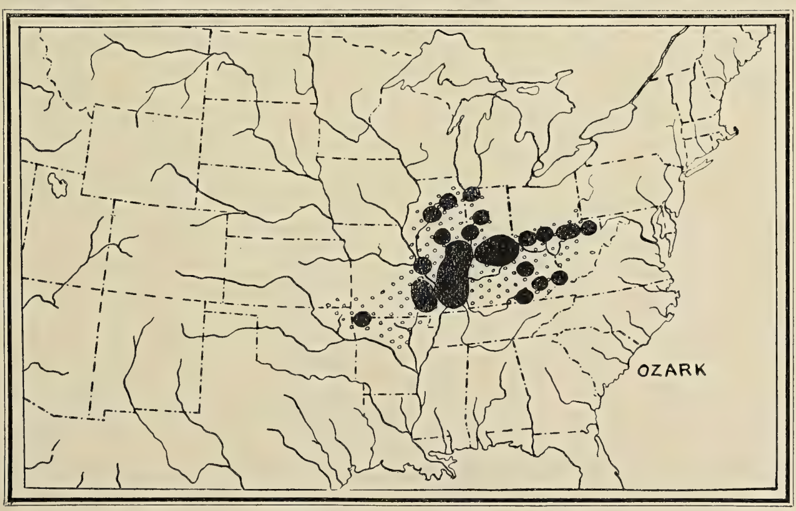


FIG. 64. OZARK VARIETY OF CYNIPS PEZOMACHOIDES

cator of *ozark* blood in a hybrid is the darker color of the face, mesonotum, and basal segment of the abdomen; but variety *wheeleri* should have much this same influence in a hybrid, so it is not always possible to distinguish *ozark* from *wheeleri* in anything but a pure population, or in a series in which pure *ozark* appears as a segregate out of the hybrid. In central Missouri and parts of central Illinois, *ozark* grades (by hybridization) into the more northern *erinacei.* One will be hopelessly confused by these various hybrids in the extensions of the range unless material from the purer population of Kentucky and the Ozark mountain region is studied first.

In the heart of the range of variety *ozark,* the spiny form of gall is more common, but the entirely naked form is also present, suggesting that this variety may have had a hybrid origin similar to that suggested for *erinacei (q. v.),* but I am at a loss to suggest possible ancestors of *ozark.* Insects bred from both types of galls of *ozark* seem indistinguishable. We located one large, isolated tree of *Q. alba* just west of Olney, Illinois, well covered with the smooth form of the galls of this species, and without a single apparent specimen of the spiny gall. The complete isolation of the tree suggested that we had here a strain which was pure for the hereditary factors for a smooth gall. Such a strain would be expected to hybridize with spiny gall forms on less isolated trees. Careful examination of the large series bred from this isolated tree fails, however, to show any morphologic character to distinguish the insects except a shorter average length. Further examination of this isolated tree in the next few years may lead to interesting data as to the possibility of such a strain maintaining its purity thru successive generations.

We have secured mature galls of this variety as early as August 2 (in 1927) from southern Illinois. Our emergence dates for the insect are November 5, 16, 18, and 20, and December 1, 4, 7, 8, 10, 12, 14, 15, 18, 19, 20, and 22.

Cynips pezomachoides variety **wheeleri,** new variety agamic form

Figures 65, 374, 417

Cynips pezomachoides var. C Kinsey, 1927, Field and Lab. Manual in Biol.: 108.

FEMALE.—The head entirely black, ordinarily without any rufous on the face laterally; the basal halves of the antennae dark brown but not rufous; the mesonotum varying from dark rufous to entirely black,

(bright rufous in some hybrids), the pronotum laterally and the mesopleuron entirely black or with touches of dark rufous; the legs dull rufous and piceous, darkest basally; the abdomen entirely black, or sometimes piceous or dark rufo-piceous basally; the mesonotum largely naked, coriaceous to smooth and polished posteriorly; more roughened anteriorly; wings averaging about 0.15 of the body in length; small insects, 1.5 to 3.0 mm. in length but averaging nearer 2.0 mm.

Hybrids with *wheeleri* are common on all boundaries of the range, and these show many rufous areas, especially on the thorax, but usually they retain the dark head, antennal, and abdominal coloration. Figures 374, 417.

GALL.—Known from both the naked and spiny forms, the spiny galls more common in the heart of the range, and probably in pure strains; on the leaves of *Quercus alba*.

RANGE.—New Hampshire: Exeter and Alton Bay (incl. hybrids with *erinacei*, Mrs. D. Tenney in Kinsey coll.).

Massachusetts: Framingham (hybrid with *pezomachoides*, C. A. Frost in Kinsey coll.). Forest Hills (hybrids with *pezomachoides;* Kinsey coll.). Sherwood (galls, C. A. Frost in Kinsey coll.). Melrose Highlands (galls, Kinsey coll.). Magnolia (gall, C. H. Clark ms. in Gray Herb.).

Pennsylvania: Meadville (incl. hybrids with *derivatus*, Roy Wilson in Kinsey coll.). Highspire (incl. hybrids with *pezomachoides*, in U.S. Nat. Mus.).

Ohio: Monterey, Coolville, and Chillicothe (incl. hybrids with *ozark* and *derivatus;* Kinsey coll.).

Maryland: Oakland (Kinsey coll.).

West Virginia: Parkersburg and Wolf Summit (incl. hybrids with *ozark;* Kinsey coll.).

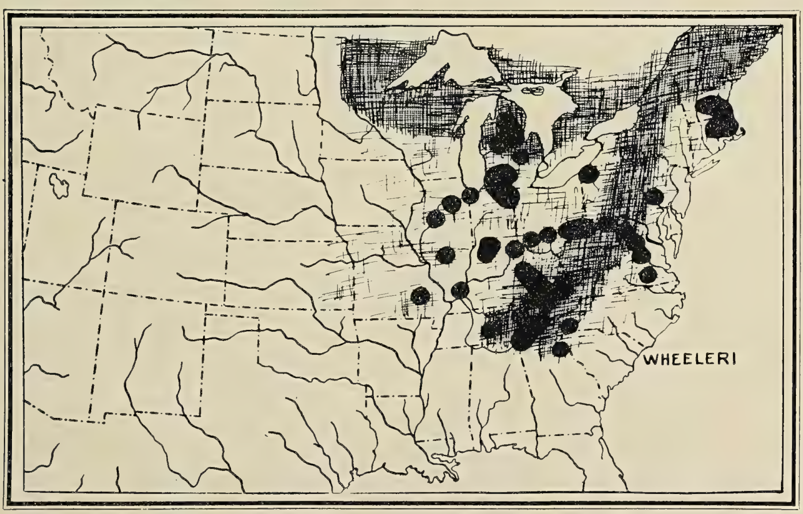


FIG. 65. SUB-CANADIAN VARIETY OF C. PEZOMACHOIDES
Southern extensions of range probably effected during Pleistocene glaciation.

Michigan: Bay City (types; also some hybrids with *erinacei;* Kinsey coll.). Flint (E. S. Anderson in Kinsey coll.). Big Rapids, Grayling, and West Branch (incl. hybrids with *erinacei,* Kinsey coll.). Tekonsha and Three Rivers (Kinsey coll.).

Indiana: Mongo, Bedford, and 7 miles east of Bloomington (Kinsey coll.). Fort Wayne (incl. hybrids with *erinacei,* Kinsey coll.). St. John and Aurora (incl. hybrids with *ozark;* Kinsey coll.).

Illinois: Sparland, Seneca, and Pana (incl. hybrids with *derivatus* and *ozark;* Kinsey coll.). Eddyville (incl. hybrids; O. Buchanan coll.).

Missouri: Arcadia (incl. hybrids with *ozark;* Kinsey coll.).

Virginia: Big Stone Gap (incl. hybrids with *erinacei,* Kinsey coll.). Flint Hill, Homeville, Golansville, and Winchester (incl. hybrids with *pezomachoides;* Kinsey coll.).

Kentucky: Berea and Pinehill (Kinsey coll.). Cleveland, Pineville, and Whitley (incl. hybrids with *ozark,* Kinsey coll.). Livingston (incl. hybrids with *erinacei,* Kinsey coll.). Hellier (hybrids with *ozark;* M. I. Spilman in Kinsey coll.).

Tennessee: Oakdale, Tazewell, Charleston, Columbia, and Madisonville (incl. hybrids named *advena,* Kinsey coll.).

North Carolina: Hendersonville (incl. hybrids with *advena;* Kinsey coll.).

Georgia: 6 miles north of Trion (hybrids with *derivatus,* Kinsey coll.). Hartwell (incl. hybrids with *pezomachoides*).

Pure populations probably restricted to the area just south of the Canadian Zone, from northern New England to Boston, and from northern Michigan to Northern Indiana. Southward, especially in the mountains, *wheeleri* appears as a segregate from hybrids all the way into Georgia and Missouri. Figure 65.

TYPES.—90 females, many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoology, the U.S. National Museum, the California Academy, Stanford University, the Field Museum, the British Museum, and the Vienna Museum. Labelled Bay City, Michigan; galls October 2, 1927; insects November 20 and December 8, 1927; *Q. alba;* Kinsey collector.

The types are selected from a series of 1045 insects from Bay City. At this locality one may find true *erinacei,* hybrids of *erinacei* and *wheeleri,* and true *wheeleri.*

The most northern collections which we have for *Cynips pezomachoides* represent localities in northern Michigan, southern Maine, and central New Hampshire. Every large series from these areas includes a goodly percentage of *wheeleri,* which is a small and very dark insect with a smooth, shining, and naked mesonotum. The remaining insects of these same series represent every gradation between *wheeleri* and *erinacei.* Out of the 1,045 insects which I bred from ma-

terial collected at Bay City, Michigan, the type locality of *wheeleri,* the percentages are

erinacei	10.2%
wheeleri x erinacei	81.2%
wheeleri	8.6%

As one goes south, the proportion of *wheeleri* decreases until it gives way to *erinacei* in northern Illinois, Indiana, and Ohio, or to *pezomachoides* on the Atlantic Coast south of Boston.

Wheeleri is also very common southward thru the Alleghanies, the Blue Ridge, the Cumberland Highlands, and even into the southern Appalachians in northern Georgia and Alabama. In this extension of range the variety parallels many of the other Canadian and Transition Zone organisms. What is certainly true *wheeleri* also appears now and then outside of the mountains as far south as Georgia and Missouri, even where other varieties of *Cynips pezomachoides* are the dominant insects. Under *erinacei* we present evidence that that variety has had a hybrid origin from a *wheeleri x derivatus* (or *wheeleri x pezomachoides*) cross, and under *advena* is presented similar evidence for origin from a *wheeleri x pezomachoides* parentage. Thus in the areas occupied by *erinacei* and *advena, wheeleri's* occasional appearance is as a segregate from the hybrids. Further, true *wheeleri* appears eastward on a part of the Atlantic Coastal Plain where it hybridizes with variety *pezomachoides,* and from Kentucky to southern Missouri *wheeleri* hybridizes with variety *ozark* (if, indeed, *ozark* is not also of hybrid origin with *wheeleri* as one parent). This widespread scattering of *wheeleri,* far beyond the northern area where the insect occurs in the purest population, is to be explained as the consequence of the southern projection of northern faunas during the Pleistocene glaciations. One examining the series which have been available for our present study must surely be impressed by the persistence, or reappearance as a segregate from hybridization, of this very distinct variety over a great area embodying most of the normal ranges of five other varieties of the species. It is noteworthy that *wheeleri* extends everywhere from fifty to a hundred miles south of the limits of glaciation, but beyond that it goes southward only in the mountains and lowlands directly adjacent to those highlands.

The galls of *wheeleri* in northern Michigan are almost al-

ways large, polythalamous, and spiny. Where *wheeleri* and *derivatus* have hybridized, as in the hybrid variety *erinacei*, smooth and intermediate and spiny galls appear in about equal numbers. The hybrid *wheeleri x pezomachoides*, which we have recognized as variety *advena* of the Cumberland Highlands and southern Appalachians, has small galls which are only very finely spiny. Where *wheeleri* comes into contact and hybridizes with *pezomachoides* further east on the Atlantic Coastal Plain, as it does commonly about Boston and thru all but the easternmost edge of Virginia, the smooth galls predominate, in many localities to the complete suppression of the spiny galls. One collecting galls in such localities would feel sure he had pure populations of *pezomachoides*, and only subsequent breeding of insects would show the *wheeleri* hybrids actually present.

The galls of *wheeleri* may be exceedingly abundant on individual white oak trees, falling to the ground still attached to the leaves in October and November. I have emergence records for November 7, 12, 13, 15, 16, 18, 20, 21, 22, 24, 25, 26, and 27; and for December 1, 4, 6, 8, 9, 10, 12, 15, 16, 17, 20, 22, 23, and 24, and January 2 and 10. Most of the emergence in the north is in the latter half of November, that further south is in the first half of December. November emergence in the north comes during colder weather than the emergence for the other varieties of *pezomachoides*. In the neighborhood of Boston, the insects remain active on cold days, and in 1917 and 1918 I repeatedly observed oviposition out-of-doors at temperatures down to 15° F. Crawling very slowly over the ice or snow-laden branches, with their antennae bent forward and moving in a way that would suggest their function as organs of smell (compare the sensory structures noted by Triggerson for variety *erinacei*), the insects finally reach dormant, lateral or terminal buds of the oak. The gall makers are negatively geotropic, as simple experimentation under controlled light conditions easily proves, and when both the light and gravity stimuli serve to send them upward they reach the tips of the branches—tho not necessarily the highest branches—of the trees. I have on several occasions observed insects start from among the dead leaves on the ground, climb the trunks of the trees, and arrive at the ends of large branches.

The antennae play rapidly over the tightly wrapped buds, but the insect may, however, turn away and retreat down the stem —its negative geotropism not strong enough to prevent—until it reaches the fork of another branch which it will ascend. Why so many of the buds should prove unsatisfactory I do not know, but it is a fact that only a few of them ultimately invite oviposition. Upon reaching these few buds, which are inspected with the tips of the antennae, the insect immediately assumes the position for oviposition, standing nearly vertically on its hind legs while grasping a bud with its second pair of legs. By a teetering motion the ovipositor is forced between the bud scales. It takes several minutes to effect oviposition, the process often terminated, as I have observed it, by the insect suddenly falling off the bud to the ground, nearly or quite dead. Perhaps this complete exhaustion does not occur on warmer days. When the insects are confined either indoors or out-of-doors where they are prevented from ovipositing, they live for as many as ten days. On several occasions I have observed them drinking from drops of the water with which I have moistened the breeding jars.

The above observations confirm and in a few points supplement Triggerson's similar observations for variety *erinacei.* When my observations were made, some years ago, I did not detect the galls resulting from the oviposition, altho I placed numbers of the insects on two different trees near Boston, and on a tree at South Orange, New Jersey. Had I then realized that Triggerson's work had such a close relation to the insects I was observing, I might have located the simple cells which are undoubtedly the galls of this bisexual generation in the buds in the spring.

My work on Cynipidae began in the fall of 1917 when the first galls I collected were specimens of the present species. I am naming this variety for Dr. William Morton Wheeler, head of the Department of Entomology and Dean of the Bussey Institution of Harvard University; who was first responsible for the suggestion that I investigate the biology of our American Cynipidae; who supervised my studies for the first three years; who was largely responsible for the grant of the Sheldon Travelling Fellowship on which I did my first extensive field work; and whose own work on the ants will be a lasting inspiration to the coördination of biologic data thru the taxonomic method.

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The dedication of the present variety is the more fitting because it was Dr. Wheeler who first pointed out to me that the Boston material of our present species showed more than usual variation. Now, after eleven years, as I come back to this New England material, I find it was thus variable because it included true *pezomachoides*, true *erinacei*, and what we shall now call *wheeleri*.

Cynips pezomachoides variety **pezomachoides**

agamic form

Figures 66, 351, 375, 418

Cynips Quercus-pisum Fitch, 1859 (gall only), 5th Rpt. Nox. Ins. N.Y., 818, fig.

Cynips quercus pisum Osten Sacken, 1861 (galls only), Proc. Ent. Soc. Phila. 1: 59. Osten Sacken, 1861 (gall only), Stettiner Ent. Zeit. 22: 408, 411. Cresson, 1862 (gall only), Proc. Ent. Soc. Phila. 1: 203.

Cynips pezomachoides Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 250. Walsh, 1864, Proc. Ent. Soc. Phila. 2: 464. Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 340, 348, 352, 353. Bassett, 1870, Trans. Ent. Soc. London: XV. Bassett, 1870, The Ent. 5: 111.

Cynips (Teras) pezomachoides Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 340, 352, 353, 379. Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.

Andricus (Teras) pezomachoides Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 370.

Acraspis pezomachoides Mayr, 1881, Gen. gallenbew. Cynip.: 30. Bassett, 1882, Amer. Nat. 16: 246. Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 295. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 178. Dalla Torre, 1893, Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich, 24: 411, 645, 817, 826. Thompson, 1915 (in part), Amer. Ins. Galls: 15, 36. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 14, fig. 3. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 58. Weld in Leonard, 1928 (in part), Ins. N.Y.: 971, 974. Houard, 1928, Marcellia 24: 110, figs. 51-53.

Cynips pisum Ashmead, 1885 (gall only), Trans. Amer. Ent. Soc. 12: 303. Ashmead in Packard, 1890 (gall only), 5th Rpt. U.S. Ent. Comm.: 109. Beutenmüller, 1892 (gall only), Bull. Amer. Mus. Nat. Hist. 4: 258. Dalla Torre, 1893 (gall only), Cat. Hymen. 2: 75. Beutenmüller, 1904 (gall only), Amer. Mus. Journ. 4: 104, fig. 34. Beutenmüller, 1904 (gall only), Amer. Mus. Guide Leaflet 16: 18, fig. 34. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 645. Viereck, 1916 (gall only), Hymen. Conn.: 376. Lutz, 1918 (gall only), Fieldbook Ins.: 462, pl. 97 fig. 3.

Acraspis pezamachoides Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127.

Acraspis erinacei err. det. Beutenmüller, 1904, Amer. Mus. Journ. 4: 104, fig. 35. Err. det. Beutenmüller, 1904, Amer. Mus. Guide Leaflet 16: 18, fig. 35. Err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 57.

Philonix pezomachoides Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 247, pl. 43 fig. 1. Thompson, 1915, Amer. Ins. Galls: pl. 3, fig. 33. Felt, 1918, N.Y., Mus. Bull. 200: 94, fig. 89 (1).

Philonyx erinacei err. det. Beutenmüller in Smith, 1910, Ins. N.J.: 598.

Acraspis quercus-erinacei Dalla Torre and Kieffer, 1910, Das Tierreich 24: 645.

Philonyx pezomachoides Beutenmüller in Smith, 1910, Ins. N.J.: 598.

Cynips pezomachoides var. B Kinsey, 1927, Field and Lab. Manual in Biol.: 108.

Diplolepis erinacei err. det. Weld in Leonard, 1928 (in part), Ins. N.Y.: 969.

FEMALE.—The head almost wholly rufous; the four basal segments of each antenna rufous, brightest on the first two segments; rufous on the entire mesonotum, the entire pronotum laterally, the mesopleuron, and all of the legs; the abdomen rufo-piceous, bright yellow rufous on the second segment basally; the mesonotum fairly naked, more or less punctate, distinctly coriaceous posteriorly; wings averaging about 0.23 of the body in length; not large insects, 2.5 to 3.2 mm. in length. Figures 351, 375, 418.

GALL.—Known definitely only from the naked form; up to 7.0 mm. in diameter; on leaves of *Quercus alba*.

RANGE.—New Hampshire: Alton Bay and Exeter (incl. hybrid with *wheeleri*; Mrs. D. Tenney in Kinsey coll.).

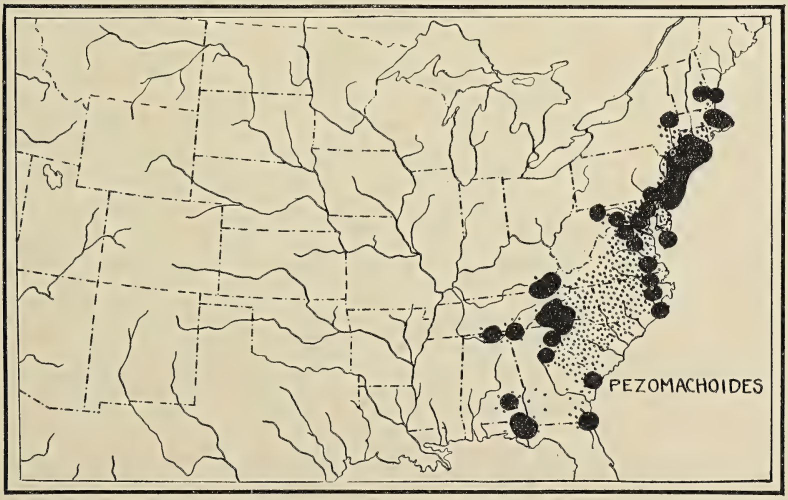

FIG. 66. COASTAL PLAIN VARIETY OF C. PEZOMACHOIDES
Possible extension of known range shown by shading.

Massachusetts: Cambridge (gall in Mus. Comp. Zool.). Forest Hills and Framingham (incl. hybrids with *wheeleri*, Kinsey coll.).

Connecticut: Waterbury (Bassett, incl. Kinsey coll.).

New York: Albany? galls, *pisum* types, Fitch coll.). New York City (acc. Beutenmüller 1892). Riverhead and Manorville (galls, Crosby acc. Weld 1926). Southold, Flatbush, West Farms, and Nyack (acc. Weld 1928).

New Jersey: Paterson (gall in Amer. Mus.). Greenwood Lake, Orange Mts., Carlstadt, and Lakehurst (galls, acc. Beutenmüller in Smith 1910). New Brunswick (spiny gall in Kinsey coll.). Medford and Pitman (galls, acc. Weld 1926). Richland (galls, Kinsey coll.). Carmel (Kinsey coll.).

Pennsylvania: Philadelphia (Bassett in Phila. Acad.). Highspire (incl. hybrids with *wheeleri*, in U.S. Nat. Mus.).

Maryland: Baltimore (types of *pezomachoides;* Dr. Morris coll.). Oakland (incl. hybrids with *erinacei;* Kinsey coll.).

D.C.: Washington (Osten Sacken 1861; also acc. Weld 1926). Rock Creek (in U.S. Nat. Mus.).

Virginia: Falls Church (gall, acc. Weld 1926). Eastville, Homeville, Golansville, Winchester, and Flint Hill (incl. hybrids with *wheeleri;* Kinsey coll.). Big Stone Gap (hybrid with *erinacei*, Kinsey coll.).

North Carolina: Cherokee, Vanceboro, Windsor, Hendersonville, and Moorhead City (Kinsey coll.). Marshall (galls, Kinsey coll.).

South Carolina: Hardeeville (Kinsey coll.). Travellers Rest (incl. hybrids with *derivatus;* Kinsey coll.).

Tennessee: Tazewell (Kinsey coll.).

Georgia: 6 miles north of Trion (Kinsey coll.). Hartwell and Madison (incl. hybrids with *derivatus;* Kinsey coll.).

Alabama: Troy and Athens (Kinsey coll.).

Florida: Jacksonville (Ashmead in U.S. Nat. Mus.). Campbellton (Kinsey coll.). River Junction (acc. Weld 1926).

Chiefly confined to the Atlantic Coastal Plain, from eastern Massachusetts to northern Florida; with some extensions further inland. Figure 66.

TYPES.—Of *pisum:* 3 galls in the U.S. National Museum. Probably from near Albany, New York; *Q. alba;* Fitch collector.

Of *pezomachoides:* Holotype (and 2 paratype females?) and galls in the Museum of Comparative Zoölogy; galls in the American Museum of Natural History.

I have examined the type galls of *pisum* in connection with the present revision. I examined the types of *pezomachoides* some years ago. The present re-descriptions are based on notes from these types, on the original descriptions, and on Coastal Plain material from New Jersey and Virginia.

INQUILINE.—*Ceroptres pisum* Osten Sacken (acc. Osten Sacken 1861).

PARASITES.—*Macroglenes q. pisi* (acc. Fitch 1859).
Pteromalus q. pilulae (acc. Fitch 1859).

This is the white oak *(Q. alba),* Atlantic Coastal Plain variety, the common *Acraspis* of the coastal region from Long Island to Florida, found in hybridization with *wheeleri* and with *erinacei* in southern New Hampshire and with *wheeleri* further south as far inland as the Alleghanies and the Great Smoky Mountains. Altho the name *pezomachoides* has hitherto been applied to all of the naked galls of this species, it should be restricted to this Coastal Plain insect, the types having come from Baltimore, Maryland. In the original description, Osten Sacken noted the large amount of rufous on the insect and the yellowish (yellow-rufous) color of the base of the abdomen, and these prove to be good key characters to the variety. We have not definitely connected insects of *pezomachoides* with the spiny form of the gall, and since we have had extensive field experience with this group, we may doubt whether *pezomachoides* ever produces anything but a naked gall. It is to be noted that the closest relative of *pezomachoides* is the exclusively naked-gall variety *derivatus.* Unlike many other Coastal Plain gall wasps, *pezomachoides* does not occur in pure colonies at any point west of the Appalachians. Instead, *pezomachoides* is replaced in southern Indiana, in the Great Valley of the Tennessee, and thruout most of Georgia and Alabama by *derivatus.* From localities in northern Alabama and northern Georgia we have both *derivatus* and *pezomachoides* with every gradation between.

Pure populations of *pezomachoides* are restricted to a narrow fringe of the northern Atlantic Coastal Plain, but *pezomachoides* blood extends a great deal further northward and westward. It is possible that our present variety was the original inhabitant or close to the original inhabitant of the whole southeastern quarter of the United States. As just indicated, *derivatus* developed from it. The sub-Canadian variety *wheeleri,* pushed southward by the Pleistocene glaciation, has largely submerged *pezomachoides* in the formation of a hybrid variety *advena* in the high country of Tennessee, and *wheeleri* also enters into hybrids with *pezomachoides* in many places east of the Appalachians.

Nevertheless, the naked gall of *pezomachoides* is apparently dominant or constitutes a selected strain wherever the *pezomachoides x wheeleri* cross occurs. In the Great Smokies and the Blue Ridge, one would believe that he was collecting galls of a pure population of *pezomachoides,* altho the bred insects

disclose the large amount of *wheeleri* blood involved; and in the Cumberlands, where the *wheeleri* influence seems greater, the galls are so finely spined that they still might pass superficial examination as *pezomachoides*. The *wheeleri x derivatus* cross, on the other hand, giving rise to the variety *erinacei*, produces a typically multiple factor series of hybrids ranging from naked to spiny galls with every intermediate between. It would be significant to know more of the genetics of these interesting insects.

Thompson's record (1915) for *pezomachoides* on *Q. bicolor* applies to some other variety or species of *Cynips*, if the record is not an error.

Beutenmüller records the gall of *pezomachoides* as fully developed in June and July (in New Jersey?). Osten Sacken found the larvae very small in the galls of the type collection (from Maryland) on June 23. In material from Washington, D.C., Weld found pupae on September 19 and adults on October 20. I have had New England insects emerge on October 31 and November 20, 24, and 25, and December 1 and 16; and insects from more southern localities on November 1, 20, 24, and 25, and December 1, 6, 8, 9, 10, 12, 15, 16, 17, 20, 22, and 23, and January 2. Specimens in the U.S. National Museum from Rock Creek, D.C., emerged December 25 (in 1908). January 7 is the record for the emergence of one of the Osten Sacken types (with two other adults alive in the galls at that date). Thus, insects may be expected from late in November, especially further north, to early in January, especially further south, with most of the emergence in December.

Bassett (1870) notes that these adult insects have a peculiar, acid odor characteristic of many subapterous Cynipidae.

In 1859 Fitch described as *Cynips quercus pisum* a long-winged insect from a naked gall of the present species. Osten Sacken (1861? and 1865) and Walsh (1864) first suggested that the insect was an inquiline, and in this they were obviously correct. The name *pisum* therefore applies to the guest insect, while the gall, in accord with usage, should take the name of the true gall maker. Whether Fitch had galls of the Coastal Plain variety *pezomachoides* or the more inland variety *erinacei* will never be known, since both may be expected at Albany, and galls alone will not separate the two. The point being insoluble and unimportant, I have retained the

current synonomy of the galls of *pisum* and true *pezomachoides* except in those cases where the records distinctly apply to the Middle Western areas in which *erinacei* occurs.

Cynips pezomachoides variety **derivatus**, new variety agamic form

Figures 67, 323-324, 376, 419

FEMALE.—The head almost wholly rufous; the whole basal half of each antenna rufous; rich rufous on the entire mesonotum, over the whole of the pronotum laterally, the mesopleuron, and all of the legs; the abdomen piceous black, red rufous on the second segment basally; the mesonotum more hairy than in other varieties, closely punctate and rather rough; wings averaging about 0.18 of the body in length; large insects 2.5 to 4.0 mm. in length. Figures 376, 419.

GALL.—The typical form always naked, noticeably large and spheroidal, up to 11.0 mm. in diameter, usually with two larval cells; on *Quercus alba.* Figures 323-324.

RANGE.—Pennsylvania: Meadville (incl. hybrids with *wheeleri;* Roy Wilson in Kinsey coll.).

Ohio: Coolville and Chillicothe (incl. hybrids; Kinsey coll.).

West Virginia: Wolf Summit and Parkersburg (incl. hybrids with *erinacei;* Kinsey coll.).

Indiana: Bedford, Bloomington, 6 miles east of Bloomington, 10 miles southeast of Bloomington, and 7 miles southeast of Bloomington (incl. hybrids; Kinsey coll.). Spencer (gall, Kinsey coll.). Clinton (hybrid with *ozark,* Kinsey coll.). Charlestown (incl. hybrids, E. W. Spieth in Kinsey coll.). Palmyra (incl. hybrids with *erinacei,* C. C. Deam in Kinsey coll.).

Illinois: Eddyville (incl. hybrids with *ozark;* O. Buchanan in Kinsey coll.). Olney and Bloomfield in Johnson County (Kinsey coll.). America (gall, Kinsey coll.).

Kentucky: Paducah and Wickliffe (incl. hybrids with *ozark,* Kinsey coll.).

Tennessee: Tazewell, Tellicoe River near Madisonville, Clinch River near Maynardsville, and Charleston (Kinsey coll.). Cades Cove (gall, Kinsey coll.).

South Carolina: Travellers Rest (incl. hybrids with *pezomachoides;* Kinsey coll.).

Georgia: 6 miles north of Trion (incl. hybrids with *wheeleri,* Kinsey coll.). Acworth (galls, Kinsey coll.). Madison and Hartwell (incl. hybrids with *pezomachoides;* Kinsey coll.). Barnesville (incl. hybrids, Kinsey coll.). Henderson and Irwinton (Kinsey coll.).

Alabama: Athens (Kinsey coll.). Troy (galls, incl. hybrids, Kinsey coll.). 13 miles north of Troy (types; also some hybrids; Kinsey coll.).

Probably thruout most of Alabama and Georgia (and Mississippi?), the entire Tennessee River Valley, the Mississippi Valley into southern Illinois, southern Indiana, and the Ohio Valley into Pennsylvania. Figure 67.

TYPES.—23 females and 42 galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the Museum of Comparative Zoölogy, the U.S. National Museum, and the American Museum of Natural History. From 13 miles north of Troy, Alabama; galls November 14, 1927; part of the insects November 20, 1927; *Q. alba;* Kinsey collector.

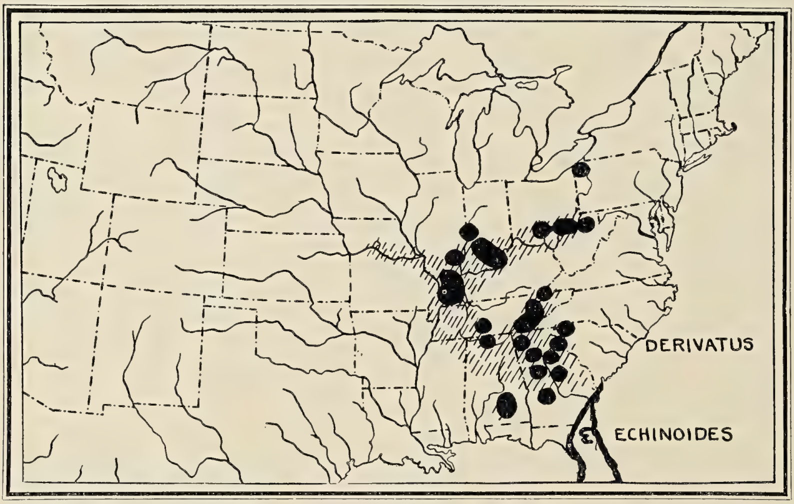

FIG. 67. INLAND DERIVATIVE OF C. PEZOMACHOIDES
Possible extension of known range shown by shading.

This is very evidently the inland equivalent of the Atlantic Coastal Plain variety *pezomachoides.* The two insects are close, and the galls are in many respects similar, but *derivatus* galls are noticeably larger than those of *pezomachoides. Derivatus* insects are most distinct in central Georgia and Alabama, but in northeastern Georgia *derivatus* grades into *pezomachoides* so gradually that the two would not be recognized as distinct in that part of the country. Further north *derivatus* occurs in the Great Valley of the Tennessee, and in the Mississippi and Ohio Valleys in western Kentucky, southern Illinois, and southern Indiana. In the latter region the variety finds its normal northern limit, but thruout the northern Middle West the species is represented by variety *erinacei,* which appears to be a hybrid of *wheeleri x derivatus*

origin (see the discussion under *erinacei*, p. 398), and thruout that region *derivatus* may occasionally appear as a segregate from the hybrid stock. This is true at least as far north as Meadville, in the corner of western Pennsylvania which fronts on Lake Erie. The series of 107 insects which I have from that locality vary from *wheeleri* thru true *erinacei* to true *derivatus*, with 41 per cent of these insects clearly *derivatus*. The characteristic gall of *derivatus* is rarely found north of southern Indiana or West Virginia, becoming submerged in the spiny to smooth galls of the hybrid series *erinacei*.

Mature galls of this variety were collected as early as September 9 (1927 at Eddyville, Illinois) and September 11 (1926 at Bedford, Indiana). Emergence dates which I have for this insect are November 12, 18, 20, 24, and 25; December 4, 5, 8, 9, 10, 14, 15, 18, 19, 21, 22, 24, and 31; and January 3.

Cynips pezomachoides variety **erinacei**

(= *C. pezomachoides wheeleri x derivatus?*)

agamic form **erinacei** (Beutenmüller)

Figures 3, 4, 68, 312-315, 328, 331, 348, 352, 420

Gall *q. erinacei* Walsh, 1864, Proc. Ent. Soc. Phila. 2: 483 [gall only].
Q. erinaceus Walsh, 1870, Amer. Ent. and Bot. 2: 299, 301.
Acraspis erinacei Mayr, 1881, Gen. gallenbew. Cynip.: 30 [no description]. Bassett, 1882, Amer. Nat. 16: 246. Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 295. Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128, 140. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 178. Ashmead, 1888, Kans. Agric. Exp. Sta. Bull. 3: IV. Gillette, 1888, Rpt. Agric. Mich. 26: 470. Gillette, 1889, Psyche 5: 186. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106. Gillette, 1892, Proc. Iowa Acad. Sci. 1 (2): 112. Beutenmüller, 1892, Bull. Amer. Mus. Nat. Hist. 4: 259, pl. 12 fig. 1. Dalla Torre, 1893, Cat. Hymen. 2: 64. Gillette, 1896, Trans. Amer. Ent. Soc. 23: 94. Bridewell, 1899, Trans. Kans. Acad. Sci. 16: 203. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Cook, 1904, Ohio Nat. 4: 142, fig. 125. Cook, 1905, Rpt. Dept. Geol. & Nat. Res. Ind. 29: 832, fig. 25. Felt, 1906, Ins. Aff. Pk. & Woodl. Trees 2: 619, 627. Jarvis, 1907, Rpt. Ent. Soc. Ont. 37: 70. Cook, 1910, Mich. Geol. & Biol. Surv. Publ. 1: 28. Baldwin, 1914, Rpt. State Ent. Ind. 6: 55. Thompson, 1915 (not all localities), Amer. Ins. Galls: 15, 35. Fagan, 1918, Amer. Nat. 52: 157. Lutz, 1918, Fieldbook Ins.: 462, pl. 97 fig. 4. Felt, 1921, N.Y. Mus. Bull. 231-232: 73. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 57. Wellhouse, 1926 (agamic form only), How Ins. Live: 316-321, fig. 143.

Acraspis pezomachoides err. det. Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 187. Dalla Torre, 1898, Cat. Hymen. 5: 293. Err. det. Bridewell, 1899, Trans. Kans. Acad. Sci. 16: 203. Err. det. Stebbins, 1910, Springfield Mus. Nat. Hist. Bull. 2: 28. Err. det. Thompson, 1915 (in part), Amer. Ins. Galls: 15, 36. Err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10) : 58. Weld in Leonard, 1928 (in part), Ins. N.Y.: 971, 974.

Cynips quercus erinaceus Dalla Torre, 1889, Cat. Hymen. 5: 329.

Acraspis erinaceae Gillette, 1889, Psyche 5: 221. Cook, 1903, Proc. Ind. Acad. Sci. 1902: 105.

Cynips q.-pezomachoides err. det. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 113.

Cynips pisum Cook, 1905 (gall only), Rpt. Dept. Geol. & Nat. Res. Ind. 29: 832. Cook, 1905 (gall only), Proc. Ind. Acad. Sci. 1904: 225. Jarvis, 1907 (gall only), Rpt. Ent. Soc. Ont. 37: 72. Jarvis, 1909 (gall only), Rpt. Ent. Soc. Ont. 39: 86. Baldwin, 1914, Rpt. State Ent. Ind. 6: 55.

Philonix pezomachoides err. det. Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 247. Err. det. Felt, 1921, N.Y. Mus. Bull. 231-232: 73. Huber, 1927, Proc. U.S. Nat. Mus. 70 (14) : 7, 71.

Philonix erinacei Beutenmüller, 1909 (not all localities), Bull. Amer. Mus. Nat. Hist. 26: 247, pl. 43 figs. 2-4 **(first description of insect).** Smith, 1910, Ins. N.J.: 647. Cosens, 1912, Trans. Canad. Inst. 9: 341, fig. 64. Viereck, 1916, Hymen. Conn.: 522. Felt, 1918, N.Y. Mus. Bull. 200: 94, fig. 89 (2-4).

Acraspis quercus-erinacei Dalla Torre and Kieffer, 1910, Das Tierreich 24: 412, 634, 812, 826, fig. 118.

Dryophanta erinacei Triggerson, 1914 (agamic form only), Ann. Ent. Soc. Amer. 7: 1-34, fig. 1-3, 5-9, 11-20, 45-53, 72-74, 88, 89, 93-98.

Philonyx erinacei Viereck, 1916, Hymen. Conn. 519. Britton, 1920, Checklist Ins. Conn.: 319.

Philonix fulvicollis err. syn. Beutenmüller, 1918, Ent. News 29: 328.

Andricus fulvicollis erinacei err. syn. Kinsey, 1920 (not all synonomy), Bull. Amer. Mus. Nat. Hist. 42: 355, pl. 31 fig. 34.

Andricus erinacei erinacei Comstock, 1924, Introd. Ent. :924, fig. 1161.

——[no name] Kinsey, 1926, Introd. Biol., fig. 271a.

Cynips pezomachoides var. A Kinsey, 1927, Field and Lab. Manual in Biol.: 108.

Diplolepis erinacei Weld in Leonard, 1928 (in part), Ins. N.Y.: 969. Gahan, Crosby, and Leonard in Leonard, 1928, Ins. N.Y.: 975, 977.

[NOT *Philonyx fulvicollis* Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 783.]

FEMALE.—Highly variable insects, a hybrid population grading from typical *wheeleri* to typical *derivatus,* averaging as follows: The head dark rufous with a black area about the ocelli and down the middle of the face to the mouth; the antennae rufous only on the first two segments; dark rufous on the entire mesonotum, the pronotum laterally black with a spot of rufous, the mesopleuron black sometimes with a

touch of rufous; the legs dark rufous; the abdomen piceous black, dark rufous to rufo-piceous on the second segment basally; the mesonotum fairly naked, with or without scattered punctation, shagreened to evenly coriaceous posteriorly, finely rugose anteriorly; wings averaging about 0.22 of the body in length; moderate sized insects 1.5 to 3.2 mm. in length. Figures 3, 348, 352, 420.

GALL.—Known from both the naked and spiny forms; on leaves of *Quercus alba.* Figures 4, 312-315, 328, 331.

RANGE.—Ontario: Toronto (acc. Cosens 1912; also Brodie in U.S. Nat. Mus.).

Maine: Kezar Falls (Mrs. D. Tenney in Kinsey coll.).

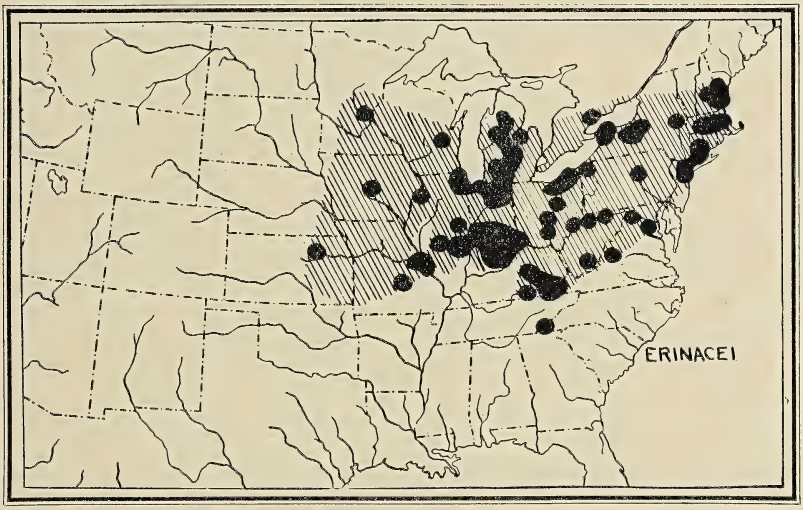

FIG. 68. NORTHEASTERN VARIETY OF C. PEZOMACHOIDES
A highly variable species apparently of hybrid origin dating from Pleistocene meeting of more northern and more southern varieties.

New Hampshire: Exeter, Alton Bay, and Dover (Mrs. D. Tenney in Kinsey coll.). Stratham (gall, Mrs. D. Tenney in Kinsey coll.).

Massachusetts: Forest Hills (Kinsey coll.). Framingham (C. A. Frost in Kinsey coll.). Springfield (galls acc. Stebbins 1910).

Connecticut: Waterbury (Bassett in Kinsey coll.). Stamford (Bartlett acc. Felt 1921: 73).

New York: Buffalo (Moeser acc. Gillette 1896). Waterport and Ithaca (galls, acc. Weld 1926). Syracuse (galls, Crosby acc. Weld 1926). Penn Yan and Albany (acc. Weld 1926). New York City (gall in Amer. Mus. and Kinsey coll.). Oakwood (W. T. Davis in Kinsey coll.).

New Jersey: Ft. Lee and New Brunswick (Beutenmüller in Amer. Mus. and Kinsey coll.). Ft. Lee (gall, Beutenmüller in Amer. Mus.).

Pennsylvania: Washingtonville (gall, E. C. Zeliff in Kinsey coll.). Meadville (Roy Wilson in Kinsey coll.).

D.C.: Washington (gall, acc. Weld 1926).

Maryland: Oakland (incl. hybrids with *pezomachoides;* Kinsey coll.).

Virginia: Bluemont (galls, acc. Weld 1926). Big Stone Gap (incl. hybrids with *pezomachoides;* Kinsey coll.). Blue Ridge Mountains near Natural Bridge Station, and Natural Bridge (galls, Kinsey coll.).

West Virginia: Beckley, Wolf Summit, and Parkersburg (Kinsey coll.).

Kentucky: Lebanon, Livingston, Cleveland, Whitley, and Pineville (incl. hybrids; Kinsey coll.).

Ohio: Elyria (acc. Weld 1926). Painesville (thru C. V. Riley, in U.S. Nat. Mus.). Wooster and Columbus (in U.S. Nat. Mus.). Rockport? (Bassett coll., Beutenmüller types). Chillicothe (Kinsey coll.).

Indiana: Mongo (incl. hybrids with *wheeleri,* Kinsey coll.). Ft. Wayne (C. M. Kinsey coll.). Crawfordsville (gall, E. C. Stout in Kinsey coll.). Ladoga (galls, H. Lee in Kinsey coll.). Porter (galls, acc. Weld 1926). Roachdale (G. Blaydes in Kinsey coll.). Putnam County (galls, acc. Cook 1902). Belmont (F. Payne in Kinsey coll.). Crothersville (galls, C. C. Deam in Kinsey coll.). Palmyra (galls, C. C. Deam in Kinsey coll.). Memphis and Charlestown (E. W. Spieth in Kinsey coll.). Greensburg and Olean in Ripley County (galls, G. F. Hyatt in Kinsey coll.). Versailles (G. F. Hyatt in Kinsey coll.). North Webster, Rochester, Huntington, and Mitchell (galls, Kinsey coll.). Bloomington, 6 miles east of Bloomington, 10 miles southeast of Bloomington, Nashville, Spencer, Bedford, and Clinton (Kinsey coll.).

Illinois: Winnetka, Evanston, Glen Ellyn, Moline (galls, acc. Weld 1926). Glencoe and Willow Springs (bisex. form, acc. Weld 1926). Ravinia (galls, Weld in Mus. Comp. Zoöl.). Urbana (galls, A. E. Miller in Kinsey coll.). Olney, West Union, and Pana (Kinsey coll.). Greenup (Kinsey coll.).

Michigan: Agricultural College (acc. Gillette 1889). Maple Rapids (E. S. Anderson in Kinsey coll.). 11 miles north of Lansing, and Mount Pleasant (A. D. Holloway in Kinsey coll.). West Branch, Big Rapids, Bay City, Grayling, Martin, Tekonsha, Three Rivers, and Owosso (Kinsey coll.).

Wisconsin: Green Lake (galls, W. Scott in Kinsey coll.).

Minnesota: Robbinsdale (galls, Ruggles acc. Felt 1921).

Iowa: Ames (Gillette in U.S. Nat. Mus.).

Kansas: no locality (Bridewell 1899). Riley County (Marlatt in Ill. Lab.).

Missouri: Barnhart (E. S. Anderson in Kinsey coll.). St. Louis (E. S. Anderson in Kinsey coll.; also acc. Weld 1926). Kimmswick (galls, acc. Weld 1926). Imperial (galls, E. S. Anderson in Kinsey coll.). Edgar Springs (galls, R. Voris in Kinsey coll.). Allenton (Letterman acc. Packard 1890: 113; also E. S. Anderson in Kinsey coll.).

Probably confined to *Q. alba* in the northeastern quarter of the United States and southern Canada, from Maine and Minnesota to

Maryland and central Missouri, excluding the Coastal Plain areas; further south in the mountains to southwestern Virginia. Figure 68.

TYPES.—18 females and galls. Holotype and paratype females and galls in the American Museum of Natural History; paratype females in the Museum of Comparative Zoölogy, the U.S. National Museum, presumably in the Beutenmüller collection, and in the Kinsey collection. From (Rockport?) Ohio; from the Bassett collection.

Walsh's original use of the name was for galls only, so Walsh "cotypes" in the Museum of Comparative Zoölogy have no nomenclatorial significance. The insect was originally described by Beutenmüller (1909) "from eighteen specimens bred by the late H. F. Bassett from galls received from Ohio." Beutenmüller "cotypes" in several collections from other localities were designated after publication and are consequently not typical.

The present re-descriptions are based on my studies of the holotype and several paratypes.

INQUILINE.—*Synergus erinacei* Gillette (acc. Gillette 1896).

PARASITES.—*Callimome brodiei* (Ashmead) (acc. Ashmead 1887).
Eurytoma auriceps Walsh (acc. Walsh 1870).
E. studiosa Say (acc. Walsh 1870).
Decatoma querci-lanae dorsalis (Fitch) (= *D. simplicistigma* Walsh; acc. Walsh 1870).
D. flava Ashmead (acc. Triggerson 1914).
D. varians Walsh (acc. Triggerson 1914).
Ormyrus ventricosus Ashmead (acc. Triggerson 1914).
Syntomaspis sp. (acc. Triggerson 1914).
Tetrastichus sp. (acc. Triggerson 1914).

This is a very common gall thruout the northeastern quarter of the United States and southernmost Canada, wherever the white oak, *Q. alba,* is found, except as this variety is replaced on the Atlantic Coastal Plain by variety *pezomachoides* and further north and in the Appalachians by variety *wheeleri* or hybrids of *wheeleri.* Buetenmüller's suggestion that this insect ranges "probably South to Florida" does not accord with our recent collections in the Southeast. The Osten Sacken (1873) and Ashmead (1890) records of *erinacei* in Colorado apply to variety *cincturata.*

Erinacei is strictly confined to *Quercus alba.* Ashmead's record (1885) of *Q. montana* as the host must be based on a mis-determination if it is not a *lapsus,* for the present species abandoned the group of oaks to which *montana* belongs when it separated from the stock of *Cynips gemmula.* Cook's repeated record (1905 and 1910) of the red oak, *Q. rubra,* as host of *erinacei* is a curious error, especially since the figure

with the 1905 publication shows a typical *Q. alba* leaf. The occurrence of a true *Cynips* gall on any tree of the black oak group is inconceivable to one who has critically observed the host distribution of cynipid genera in general.

The type material of *erinacei,* from north-central Ohio, represents an insect with a dark rufous head which is prominently marked with black on the mid-line, with antennae which are rufous only on the first two segments, a dark rufous mesonotum, and a piceous black abdomen which is dark rufous basally. This combination of characters is represented by insects in our collections from nearly one hundred localities scattered all the way from southern Maine and Minnesota to southwestern Virginia and Missouri, but in practically all of these localities such insects have been obtained from both naked and spiny forms of the gall, and from every conceivable intermediate type of gall. The extreme variation of the gall is matched, moreover, by the variation of the insects in every large series which we have from localities representing the wide range of *erinacei.* The significance of this variation is elucidated by the occurrence of true *wheeleri* as one extreme of these variable series and (in most places) of *derivatus* as the other extreme of each series. Usually the *wheeleri* and *derivatus* individuals are few in comparison to the intermediates, but from Meadville, in the northwestern corner of Pennsylvania, we have 107 insects of which 41 per cent show distinct *wheeleri* influence, 37 per cent *derivatus* practically identical with the Alabama and Georgia material of that variety, and 21 per cent good *erinacei.* This series, like all the others, shows every gradation from *wheeleri* to *derivatus,* and the types called *erinacei* are matched by individuals near the mean of the series. There is little room to question that *erinacei* has come from the hybridization of *wheeleri* and *derivatus,* probably effected when the Pleistocene glaciation forced the sub-Canadian variety southward into the range of *derivatus.* Upon the retreat of the glaciers, the hybrid found a great territory in the northern Middle West where it was sufficiently isolated from the rest of the species to gradually assume, thru the endless inbreeding of the hybrid individuals, a certain homogeneity which warrants its taxonomic recognition. *Erinacei* is much like a West Indian or Northern African mulatto people (to illustrate from two very different types) which, originating from white and black crosses, and so isolated as to

favor inbreeding of the hybrids, have developed more uniform populations than a mulatto people of more immediate origin would show.

The typical gall of *wheeleri* is spiny; the gall of pure *derivatus* is always smooth and naked. The occurrence of typical spiny and naked galls in the *erinacei* population is to be explained as the segregation of the parental types from the heterozygotic individuals. The occurrence of intermediate types of galls is what we should expect if the gall producing capacities of the insect are controlled by multiple factors in heredity. On the other hand, in the eastern extension of the range of *erinacei*, at least in northern New England and again in Virginia, *erinacei* comes into contact with variety *pezomachoides* and probably interbreeds with it. It is even possible that what we are still calling *erinacei* is a *wheeleri x pezomachoides* cross in these localities. *Pezomachoides* and *derivatus* are so similar that I cannot distinguish between their influence in a series of hybrid insects, but there is a notable difference in the galls from these two hybridizations. Wherever *erinacei* comes into contact with *pezomachoides*, almost all of the galls are as naked as those of *pezomachoides*. There are not even as many of the spiny galls in such parts of the country as we should expect to segregate from any sort of hybridization; and it is possible that there are hereditary or environmental factors which select in favor of the *pezomachoides* type of gall in such localities. Histologic studies of both the naked and spiny forms of the galls of *erinacei* have been made by Cook and by Cosens, both of whom are quoted in the general discussion introducing this species in the present paper.

The abundance and the conspicuous nature of the spiny galls of *erinacei*, together with the realization that the agamic, short-winged, mid-winter female was probably followed by a bisexual, spring generation, has resulted in the accumulation of considerable data on the life history of the insect. On the basis of laboratory and field observations of insects from spiny galls of this variety, Triggerson in 1914 reported, from the Entomological Laboratories of Cornell University, the alternate generation of this insect in one of the most detailed studies that we have of the life history of any American cynipid.

The young galls of the agamic form appear late in June

(June 25 acc. Triggerson, June 28 at Toronto acc. Brodie coll.), reaching full development in August (August 17 in northern Indiana in 1927) or early September (mid-September in southern Indiana). When the hypertrophied tissue first pushes thru the slightly ruptured epidermis of the leaf, the embryos, according to Triggerson, "measured 125 μ.-130 μ. In galls gathered on the first and second of July, larva were found measuring 374 μ. These were similar to the young larva which give rise to the sexual form, having a slightly depressed head, sharp pointed mandibles, broad, prominent thorax, and pointed, reflexed abdomen. During the summer, molts were observed after which the larva measured 500 μ., 750 μ., 1¼ mm., 1¾ mm., 2¼ mm., respectively, thus showing five stages during the life-history. . . ." From about the middle of August "the thorax does not show a great increase in size, but the abdomen loses its reflexed character, becomes globose, and increases in size until pupation." Triggerson obtained the first pupae on the 5th of September. Weld found pupae on September 8 (1906), near Chicago. The galls fall with the leaves to the ground late in September or October, or some of them remain with the leaves on the trees. Transformation probably occurs soon after pupation, but emergence of the adult does not ordinarily occur until some time after that. For breeding purposes, the galls are best left on the trees until just before the adults are due to emerge.

Our records for emergence range from early in October to early in January, with the bulk of the adults coming out in November. Actual dates from published records, Museum collections, and my own breedings are October 3, 7, 10, and 31; November 1, 5, 7, 12, 13, 15, 16, 18, 20, 22, 26, and 27; December 1, 4, 5, 8, 10, 12, 14, 16, 17, 20, 21, 22, 23, 25, and 28; and January 1 and 3. In spite of these widely distributed dates, most of the emergence occurs late in November and early in December. I have not been able to discover any correlation in these records between the latitude of the locality and the time of emergence of this insect.

Triggerson's designation of November 5 to 21 and rarely in early December for the emergence of *erinacei* is evidently based on a single season's observations in a single locality. The emerged insects, according to Triggerson, "are most active on cold days or early in the morning. During the warm

weather they are inactive and sluggish, hiding at the base of the petioles, in the crotches of the young shoots, or in the crevices of the bark." The same observer adds that these insects usually succumb to the first heavy frosts, but Weld records the wasps emerging and ovipositing on a cool day when scattered flakes of snow were flying, and in my own abundant observations I have found many of the insects emerging and active at temperatures below freezing.

Oviposition is in the leaf or flower buds of the white oak. The behavior is described by Triggerson as follows: "The insect clasps the apical portion of the bud with the second pair of legs . . . . and pressing alternately with the first and third pair produces a teetering motion which forces the ovipositor into the buds. The long ovipositor lifts the apical edge of the outer scale, and is gradually pressed down along the edge of succeeding scales, and finally thrust into the region of the young leaf and flower. Then there is a sudden jerk of the body which curves the distal end of the ovipositor, turning the openings against the concave face of the innermost scale. The insect now retains a motionless attitude for almost four minutes, during which the egg is deposited. The ovipositor is then withdrawn, the passage being filled with a waxy substance for the protection of the egg. This waxy secretion is doubtless from the accessory glands of the reproductive system, and is homologous with the secretions with which *Corydalis cornuta,* certain of the Lepidoptera, as the Apple Tent-Caterpillar, the Tussock-moths, and many other insects cover their eggs.

"The egg . . . is an oval body 400μ. x 225μ. provided with a pedicel which is 1 mm. in length. It is attached by this pedicel to the upper brown portion of the scale, falling either against the green portion of the scale . . . or being held among the young leaves or flowers, in which position it remains during the winter. It is worthy of emphasis that this pedicel does not constitute the apical pole of the egg since the larva emerges from the opposite pole, and as already indicated it serves as an appendage for attaching the egg to the bud scale."

The galls of the succeeding, bisexual generation develop early in May as minute, egg-shaped cells in the buds or attached to the developing leaves or flowers. The bisexual generation is described in the present paper as form *bicolens.*

Triggerson figures the spiny galls of the agamic *erinacei,*

including longitudinal sections, reproduces photographs of the pupae and a small photograph of the agamic female ovipositing in a bud, includes drawings of the eggs with figures of the eggs in position on the bud scales, gives details of wings, some of the mouthparts and antennal segments, including the sensory pits of the terminal segments of the antennae (structures which may serve the insect in finding its host and the buds suitable for oviposition), details of larval chaetotaxy, and histologic sections of the larvae showing especially the Malpigian tubules and oenocytes.

There are nine species of parasitic hymenoptera recorded from these galls. Triggerson found these "primarily parasitic on . . . *erinacei*, and secondarily on each other." Two-thirds of the nearly one thousand parasites that author bred were determined as *Decatoma flava* (Ashmead). The parasites were observed ovipositing about the middle of June (June 10 to 14), *Decatoma flava* selecting a spot on the mid-rib where the gall maker had oviposited, thrusting its ovipositor down alongside the same channel, depositing a single egg in contact with that of the cynipid, and finally sealing the opening thru which the egg had been placed. The two species of *Eurytoma* oviposited in the fibro-vascular bundles of the leaf, near but not in contact with the egg of the cynipid, the eggs of these parasites being layed in clusters of up to six.

Quoting again from Triggerson: "When the larva of *Dryophanta erinacei* emerges from the egg, it proceeds at once to form a cavity which encloses the eggs surrounding it. In newly-forming galls the cavity is small, and the egg of the parasites is frequently found resting in the abdominal angle of the larva of *Dryophanta erinacei*. Here it often hatches. The larva breaks the shell near the base of the neck . . . and emerges, proceeding to attack the host in the abdominal region. If the Cynipid larva has just molted it is destroyed at once. If on the other hand, it escapes the attacks of the parasites during this period, they will live together until the next molt occurs, when the host is almost invariably killed and eaten. Only on rare occasions have the host and parasite been found living together in the same cavity until both have reached 1 mm. in length.

"If two parasitic larvae of the same or different species are found in one cavity in the early stages, the stronger alone

survives, for I never have observed more than one adult emerge from a single cavity."

Decatoma flava apparently has only a single brood annually, but each of the two species of *Eurytoma* has a brood that emerges from the young galls from July 24 to August 1, and a brood that does not emerge until the middle of the following June. "After the parasites have destroyed the host, it is questionable whether they feed on the plant tissue, since the lining of the cavity they inhabit turns brown, becoming hard and brittle much earlier than is the case with the cavities occupied by *Dryophanta erinacei*."

Of 1050 galls which this observer examined, sixty per cent [of the galls or larval cells?] were parasitized. I have found a similarly high percentage of parasitism in material from several localities, but in more than a thousand galls from Big Stone Gap, Virginia, and many hundreds of galls from each of a dozen other localities I found a parasitism which I should roughly estimate as not more than five or ten per cent. Altho I have at times published data on the percentage of parasitism of cynipid galls, I have come to believe that the conditions vary so greatly in different localities and in different seasons that it will be difficult ever to arrive at an estimate that will fairly represent the amount of parasitism normal for any species.

Triggerson studied *Synergus erinacei*, finding it present in these galls not only as a guest but as a parasite which fed directly on the larvae both of the gall maker and of the parasites. On eight occasions Triggerson fed gall maker and chalcidid larvae directly to the *Synergus* larvae, altho only once was he able to feed them larvae of their own species. The inquiline even mines from cavity to cavity of the polythalamous galls. It is to be questioned whether such mining is primarily in search of food or an evidence of primitive, phytophagous behavior such as was probably the ancestral right of the Cynipidae. Triggerson observed over eighty instances of such mining by this *Synergus*. "The average time required by *Synergus erinacei* to consume a larva was 1½ hours." This insect was found to have two broods each year, the larvae of the broods differing in some respects, but the observer did not record whether there is anything in this inquiline that approaches the heterogeny of so many of the gall making species.

Five pages of Triggerson's paper are given to the life history of the gall maker, and another five pages to the parasites and inquilines. The remaining fourteen pages are given to an interesting if unconvincing discussion of the stimulus to gall production. Following a suggestion of Rossig's (1904), Triggerson studied the Malpighian tubules of *erinacei* and concluded that they "secrete a fluid which stimulates the plant to produce the gall." He summarizes his reasons for so believing as follows:

A. The character of the Malpighian vessels of the sexual and agamic forms of *Dryophanta erinacei*—their size, cellular structure, and exceptional glandular activity.

B. The character and effect of the secretion poured forth by the Malpighian vessels during gall formation.

C. The ultimate decline and ceasing of marked activity of the tubules when the gall has matured.

D. The increase in the size of the cells of the Malpighian vessels coincident with the development of the gall, and their decrease in size when the demand upon them is withdrawn.

E. A comparison of the Malpighian vessels of *Dryophanta erinacei* with those of the parasites and the inquilines found in the gall, and particularly the lack of any abnormal secreting activity in the latter.

F. A study of the Malpighian vessels of *Holcaspis globulus,* and *Dryophanta polita,* both of which correspond in their action, development, and degeneration to those of *Dryophanta erinacei.*

G. A comparative study of the Malpighian vessels of *Dryophanta erinacei* with those of *Nematus pomum, Trypeta solidaginis,* and *Cecidomyia strobiloides* shows that all the latter, though gall producers, possess tubules of normal type, which do not pour forth an abundant secretion during gall development, nor when in contact with foreign substances.

H. The study of the Malpighian vessels of species of Braconids and Ichneumons, shows tubules with cells not larger than those of the Chalcids and inquilines. The mode of degeneration however, appears similar to that found in *Dryophanta erinacei.*

While I do not believe that Triggerson's data fully support the conclusion on the gall making stimulus, this paper should be carefully weighed by some future investigator whose studies will include a wider selection of gall wasps. Convincing proof of the source of the stimulus must include the artificial production of a specialized gall, or at least the control of gall production by the control of the suspected gall producing structures of the larval cynipid. Further discussion of this ques-

tion is unnecessary in the present taxonomic study. Triggerson's original paper should be consulted for details that we have not quoted here.

Cynips pezomachoides variety **erinacei**
bisexual form **bicolens** (Kinsey)

Figures 1, 2, 5, 68, 311, 332, 347, 353, 406

Dryophanta erinacei Triggerson, 1914 (bisex. form only), Ann. Ent. Soc. Amer. 7:1-34, fig. 4, 7, 9, 10, 21-29, 36, 70. Wieman, 1915, Biol. Bull. 28: 34-46.

Cynips erinacei Felt, 1918, N.Y. Mus. Bull. 200: 75.

Andricus fulvicollis form *bicolens* Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 354, pl. 31 fig. 33.

Andricus erinacei bicolens Comstock, 1924, Introd. Ent.: 924.

Acraspis erinacei Weld, 1926 (bisex. form only), Proc. U.S. Nat. Mus. 68 (10): 57. Wellhouse, 1926 (bisex. form only), How Ins. Live: 316-321, fig. 144.

Diplolepis gemula err. det. Weld, 1926 (in part), Proc. U.S. Nat. Mus. 68 (10): 26.

——[no name] Kinsey, 1926, Introd. Biol., fig. 271b.

Dryophanta erinacea Schröder, 1928, Handbuch Ent. 1: 998, 1000.

FEMALE.—As described for the species *(q.v.)* The entire body rufopiceous to black, the antennae brown, yellow on the first two segments; the mesonotum mostly smooth and naked but not shining, in no place rugose; the parapsidal grooves extending two-thirds of the way to the pronotum but distinctly discontinuous anteriorly; the scutellum finely rugose and finely hairy posteriorly, smoother and naked anteriorly; the ridge between the scutellum and the rest of the mesonotum fine and not always definite; length 1.7 to 2.2 mm. Figures 1, 347, 353, 406.

MALE.—Differing from the bisexual female as described for the genus and species *(q.v.)*. The antennae entirely brown. Figure 2.

GALL.—As described for the species. A seed-like, egg-shaped, or more compressed, elongate cell in the buds of *Quercus alba.*

RANGE.—Undoubtedly as indicated for the agamic form *erinacei* (fig. 68); in the northeastern quarter of the United States and southern Canada, from Maine and Minnesota to Maryland and central Missouri. Known definitely from:

New York: Ithaca (acc. Triggerson 1914).

D.C.: Washington (acc. Weld 1926).

Ohio: Cincinnati (acc. Wieman 1915).

Indiana: Miller (acc. Weld 1926). Charlestown and Memphis (E. W. Spieth in Kinsey coll.). Clinton (Kinsey coll.).

Illinois: Ravinia (types, Weld coll. in Mus. Comp. Zool.). Glencoe, Winnetka, and Willow Springs (acc. Weld 1926).

Kentucky: Paducah (variety? Kinsey coll.).

TYPES.—1 female and 1 male in the Museum of Comparative Zoölogy. From Ravinia, Illinois; May 1, 1916; *Q. alba;* L. H. Weld collector.

While *bicolens* is unknown except from Triggerson's and Wieman's studies, Weld's material, and my southern Indiana and Kentucky series, the insect is of course to be expected wherever the galls of the agamic generation occur in abundance. The galls of *bicolens* are not usually visible until after the buds have opened and, as Weld (1926), suggests, "The easiest way to rear the flies is to locate a tree in the fall well infested with the hedge hog gall and from this tree gather twigs in the spring just before the buds start, putting them in a bottle of water and setting the whole in a battery jar with a cloth over the top."

This bisexual insect is very close to *gemmula,* the bisexual form of *prinoides;* and the bisexual forms to be discovered for for the other eastern species and varieties of *Acraspis* will probably need careful comparisons in making determinations.

Altho the agamic females have oviposited late in the fall or early winter, it is not until nearly six months later, after the middle of April, that the eggs hatch. Adults were mature and emerging from my southern Indiana material on April 22 and May 1, 8, and 9 (1927). Wieman (1915) secured adults at Cincinnati over a period of two weeks beginning April 23, 1914. Weld (1926) reports pupae near Chicago on April 28 (1913), and adults on May 1-20 (in 1913), on May 6 (1924 at Washington), and May 17 (1909 near Chicago). Triggerson, who first recognized on the basis of both laboratory and field observations, that this represents the bisexual generation of *erinacei,* did not find the eggs hatching to produce these bisexual insects at Ithaca, New York, until after May 8. Quoting from Triggerson:

"On the twelfth of May a slight swelling, at the apex of which an empty egg shell was visible, appeared on the lower green portion of the scale . . . This proved to be a freshly formed gall, containing a young larva of *Dryophanta erinacei.* The gall at this stage was thin-walled, with a pebbled surface, greenish in color, and contained a watery fluid. The egg-shell remains attached to the apex of the gall until the latter has reached considerable size, when it dries up and disappears. These hypertrophies develop rapidly, as many as three appearing on one scale. The wall of the gall has by this time

changed to a yellowish brown color, and soon becomes quite dry and brittle.

"Galls also develop on the apical portion of the leaf and flower buds . . . The terminal galls are of the same size as those on the scales, varying in number from one to four, and when mature are reddish brown . . . males and females similar in size and character emerge from the two galls. . . . The difference in color in the galls is due to the normal difference of the tissue of which they are formed.

"Shoots were brought into the laboratory, placed in water and covered with bell jars. Here about noon on the twenty-first of May the first male and female emerged. They were quite vigorous, and about four-thirty in the afternoon the female was noticed actively moving along the midrib of the young leaf. Suddenly she stopped, and set up a rapid nodding motion which lasted thirty-five seconds, during which the ovipositor was thrust into the tissue. The insect remained motionless for a time, then withdrew the ovipositor, filling the passage with a yellow substance which, as in the agamic form, is probably a secretion poured forth by the accessory glands of the reproductive system. The process was repeated four times in succession without moving the body forward. Each time the ovipositor was inserted the body was curved slightly more than at the preceding puncture. The entire time occupied by the four ovipositions was from four-thirty-four to four-fifty, or sixteen minutes, thus allowing four minutes to each oviposition of which a little over two minutes and a half was occupied by the passage of the egg. Many other observations were made, and the time in all instances corresponded to the first recorded.

"While the first observations of oviposition were made without having seen copulation occur, in all the following instances it was observed. The male strikes the female several times with the antennae after which the latter rests quiet. The male then clasps her thorax latero-caudad of the second pair of wings with the second pair of legs, while the first pair rest on the dorso cephalic portion of the thorax, and the third pair extend slightly latero-cephalad of the abdomen; copulation takes place, lasting for a few minutes.

"The egg of the sexual form . . . is oval, 160 μ. x 450 μ. provided with a pedicel 750 μ. in length, which is shorter

than in the agamic form. It is always placed in the fibro-vascular bundles, and at an angle of about 80° to the axis of the leaf. The egg differs from that of the agamic form only in the elongate portion being shorter.

"The larva is characteristic of the Cynipidae, having a slightly depressed head, fine needle-like mandibles, broad thorax, and reflexed pointed abdomen. During development the abdomen does not become as enlarged as in the agamic form. The thorax also continues prominent throughout all larval stages, which is not the case with the agamic form. . . .

"In the open the adults did not emerge until the twenty-ninth of May, and continued to oviposit from that time until the fifth of June. Oviposition here was as observed in the laboratory, the time occupied corresponding exactly to that already noted."

In this 1914 paper, Triggerson includes a small photograph of the female of this form, figures the young galls in the bud scales, details the mouth parts, wings, and antennae—the latter showing sensory pits similar to those of the agamic female—and figures the egg of this insect. He also shows a longitudinal section thru a larva including a portion of the Malpighian tubule.

Wieman (1915) has studied the spermatogenesis of the male of the bisexual *erinacei*. He admits his conclusions as somewhat uncertain and perhaps open to question because of difficulty in seriation of his sections, and more especially fragmentary because the maturation stages of the eggs of this generation and of the agamic female were not studied. In the male he found "but one true maturation division, namely that of the second spermatocyte. The first spermatocyte division is indicated by the pinching off of a small quantity of chromatin-free cytoplasm which forms the so-called polar body." In the second division "it would seem that each chromosome is divided quantitatively by a longitudinal splitting; although it must be remembered that attempts at verifying this conclusion by studying the constituents of the daughter groups [were] not satisfactory owing to the tangled condition of the chromosomes." Counts in the metaphase seemed to show 12 chromosomes as, presumably, the haploid number. Counts of somatic tissues of the male, although not conclusive, also

seemed to give 12 as the normal number. Counts of female somatic tissues seemed near this same number, the best preparations, coming from follicle cells of the ovary, giving counts of 13, 14, and 13, respectively.

Wieman's findings are unexpected, for among many Hymenoptera the males are haploid because they are produced parthenogenetically from eggs in which reduction has occurred, but the females are diploid because, if they are produced parthenogenetically, they come from eggs in which reduction has not occurred. Doncaster's work (1910-1916) seems to confirm this general statement for the cynipid species *Neuroterus baccarum*, and Patterson (1928) accepts this as the explanation of the demonstrated fact that agamic Cynipidae are apparently of two sorts: those that produce females only (because no reduction occurs), and those that produce males only (because reduction does occur). If Wieman's results are acceptable, they suggest that the bisexual female is haploid as well as the male, for even if the accuracy of the somatic count on *erinacei* is open to question, the count falls short of the expected 2X number of 24 chromosomes. Wieman suggests that the slight difference between the male and female counts in this species is due to the presence of true sex chromosomes in the female. Either Doncaster or Wieman is wrong in the cytologic findings, or, if both are correct, there is more than one type of maturation involved with the alternation of generations of diverse species of Cynipidae. It is highly desirable that Wieman's brief investigations be extended by further work on *erinacei.*

Cynips pezomachoides variety **advena,** new variety

(= *C. pezomachoides wheeleri x pezomachoides?*)

agamic form

Figures 69, 319-320, 377, 421

FEMALE.—Highly variable insects, a hybrid population grading from typical *wheeleri* to typical *pezomachoides* in all characters, the average more nearly represented as follows: Head bright rufous with black over much of the front and on the median line of the face; the antennae black, varying from piceous on the first two segments to brown on the whole basal half of the antenna; the mesonotum bright rufous, the pronotum largely bright rufous laterally but black on the edge, the mesopleuron largely black with touches of rufo-piceous; the legs largely

bright rufous, sometimes darker, with at least the bases of the coxae black; the abdomen varying from entirely black to piceous with a small to a large rufo-piceous to yellow-rufous patch at base; the mesonotum largely naked, finely roughened; wings varying, from 0.17 to 0.23 of the body in length; rather small insects, 2.1 to 3.0 mm., most of the individuals close to 2.5 mm. in length. Figures 377, 421.

GALL.—Variable, but usually closer to the naked, spherical *pezomachoides* than to the elongated, spiny *wheeleri* gall; the great majority of the galls of *advena* small, irregularly spherical, with the tips of each facet slightly elongate so the gall appears short-bristly but not spiny; on leaves of *Quercus alba*. Figures 319-320.

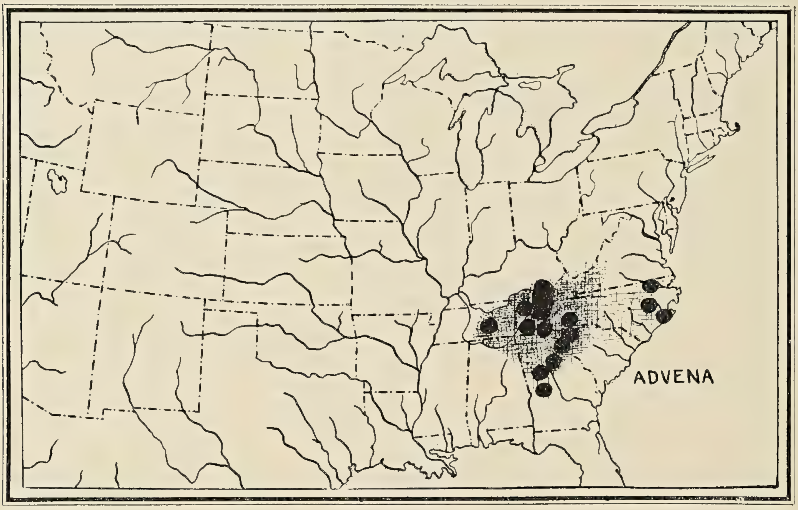

FIG. 69. SOUTHERN HIGHLAND VARIETY OF C. PEZOMACHOIDES

Probably hybrid of Canadian and Coastal Plain varieties brought together in Pleistocene.

RANGE.—Kentucky: Pineville (Kinsey coll.).

Tennessee: Oakdale (types, Kinsey coll.). Columbia, Charleston, Tellicoe River near Madisonville, Clinch River near Maynardsville, and Tazewell (Kinsey coll.).

North Carolina: Windsor, Moorhead City, Vanceboro, Hendersonville, and Murphy (Kinsey coll.).

South Carolina: Travellers Rest (Kinsey coll.).

Georgia: Hartwell, Madison, Barnesville, and Henderson (Kinsey coll.).

Largely restricted to the Cumberland Highlands, the Great Smokies, and the southern end of the Blue Ridge, scatteringly found eastward to the coast of the Carolinas and southward into Central Georgia. Figure 69.

TYPES.—332 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls

in the Museum of Comparative Zoölogy, the U.S. National Museum, the American Museum of Natural History, the Field Museum, the California Academy, the Illinois Laboratory of Natural History, the British and Vienna Museums, and Stanford University. Labelled Oakdale, Tennessee; galls November 5, 1928; insects December 1, 8, 15, and 22, 1928; *Q. alba;* Kinsey collector.

In the southern Highlands of Central and Eastern Tennessee, the Carolinas, and more northern Georgia, *Cynips pezomachoides* is represented by a small insect which produces a small, nearly naked or at the most a slightly bristly gall that is very similar to the gall of variety *pezomachoides* but recognizably distinct over this territory. One who has collected these small galls during the cold fall rains of the southern hill and mountain country cannot fail to have realized that they stick to the wet soil unlike the entirely smooth galls of *pezomachoides,* and yet are so much smaller than the spiny galls of any other variety of the species that they elude one's cold finger-tips in an exasperating way.

The insects bred from these galls are puzzlingly variable. Some of them approach true *wheeleri* of the most northern parts of the United States. Some of them seem good *pezomachoides.* Most of them are everything between the two extremes. This extreme variation and the occurrence of both *wheeleri* and *pezomachoides* in the population suggests that this variety is of hybrid origin from the two varieties named. The uniform variation of this population everywhere over this considerable range, its rather distinctive gall, and the absence of any other representative of the species from most of this area are considerations entitling this hybrid to taxonomic rank, just as another hybrid, *wheeleri x derivatus,* is the well-known variety *erinacei* of the more northern Middle West. The occurrence of variety *pezomachoides* or its close relative *derivatus* over so much of the South, suggests that the *pezomachoides* heritage of *advena* dates from a time when *pezomachoides* or its ancestral stock covered these southern highlands as well as the lowlands. The *wheeleri* blood in *advena* probably came in during the Pleistocene glaciation. Most of Central and Eastern Tennessee, excepting the Valley of the Tennessee River, is hill or mountain country connected by way of the northeastern corner of the state with the rest of the Appalachian system, and thru these mountains the northern *wheeleri* appears to have migrated as far south as

Georgia during the Pleistocene. One thus finds a more northern influence in the cynipid fauna of most of Tennessee than is to be found, for instance, in the southern third of Indiana.

The insects of *advena* have emerged in our cages on November 22, 24, 25, and 26; December 1, 4, 5, 7, 8, 9, 10, 12, 15, 16, 21, 22, 23, and 24; and January 4 (1927 to 1929), with most of the emergence nearer the middle of December.

Cynips pezomachoides variety **echinoides**, new name

agamic form

Figures 67, 378, 422

Acraspis echini Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 128, 140. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 310. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 109. Dalla Torre, 1893, Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 412, 812, 827. Thompson, 1915, Amer. Ins. Galls: 15, 35. Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 14.

Philonix echini Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 248 (and pl. 43 fig. 5 ?). Felt, 1918, N.Y. Mus. Bull. 200: 94 (and fig. 89 (5) ?).

[NOT *Cynips quercus echinus* Osten Sacken, 1870, Trans. Amer. Ent. Soc. 3: 56.]

FEMALE.—The entire head, the entire thorax, and the abdomen bright, rich rufous, slightly darker in only a few places; the antennae bright rufous basally, darker to dark brown terminally; the mesonotum entirely punctate; the wings averaging about 0.19 of the body in length; large insects 3.2 to 4.6 mm. in length. Figures 378, 422.

GALL.—Known only from the spiny form; on leaves of *Quercus bicolor*.

RANGE.—Florida: Jacksonville (Ashmead; types).

Not certainly identified from other localities and the data insufficient to predict the further range. Figure 67.

TYPES.—Of *echini:* Holotype and a paratype female in the U.S. National Museum; 7 paratype females and galls in the Philadelphia Academy. From Jacksonville, Florida; November; *Q. bicolor;* Ashmead collector.

The present re-descriptions are based on my studies of all this material. The material is now designated as type of the new name *echinoides*.

This insect is recognizable by its nearly uniformly bright rufous color, its more shortened parapsidal grooves, and its usually larger size. It is known only from the type material,

and this is insufficient data to show whether the variety ranges on the swamp white oak, *Q. bicolor,* thruout the Atlantic Coastal Plain area, or along the Gulf into eastern Texas, or is confined to Florida.

Ashmead described the galls as precisely similar to those of "*erinacei,*" meaning a spiny form of this species. The gall described and figured by Beutenmüller, perhaps from the type material in the Philadelphia Academy, is intermediate between the naked and spiny forms. There are no galls among the types in the National Museum.

Ashmead bred adults in November. He expressed surprise that he had found this species on *Q. bicolor* without finding it on *Q. Prinus,* for, he says, *Q. bicolor* "is considered by many botanists only a variety of *Quercus prinus;* galls found on one are very apt to be found on both, and insects are good botanists." As a matter of fact, these insects are better judges of the relationships of the oaks than anyone who would consider *Q. bicolor* a variety of *Q. Prinus.* Long ago in the history of our insects there was a division on this very question, and *Cynips gemmula* and its varieties claimed the exclusive rights to *Quercus Prinus, prinoides, Michauxii,* and *Mühlenbergii,* while *Cynips pezomachoides* accepted *Q. alba* and *bicolor.* Modern botanists acknowledge this to be the correct grouping of these oaks (cf. Trelease, 1924, Nat. Acad. Sci. Mem. 20:102-111). *Echinoides,* as a variety of *pezomachoides,* is not departing from the ancestral traditions when it takes up its dwelling on *Q. bicolor.*

Cynips (Acraspis) hirta Bassett

agamic forms

FEMALE.—Thorax much reduced and narrowed; the mesonotum entirely rugoso-punctate and hairy; parapsidal grooves poorly indicated, short, discontinuous anteriorly; anterior parallel lines and median groove entirely absent; lateral lines present or absent; scutellum irregularly rugoso-punctate and hairy, narrow and elongate, the tip moderately pointed, anteriorly depressed; the ridge separating the scutellum from the rest of the mesonotum fine and indefinite; mesopleuron mostly or entirely punctate and hairy, in some varieties with a more naked and shining area; abdomen enlarged, compressed, elongate, but not much produced dorsally, the second segment covering less than half of the abdomen, the sides of segments 2 to 5 entirely tho not densely hairy;

wings much reduced, from 0.21 to 0.35 of the body in length, with hardly a trace of any of the veins; length 1.5 to 3.5 mm.

GALL.—Small, ellipsoid to spheroidal, with faceted surfaces. Always monothalamous, up to 6.0 mm., usually nearer 4.0 mm. in diameter; symmetrically ellipsoid to spheroidal; the surfaces closely set with broad, polyhedral bodies, giving a faceted appearance, these bodies sometimes set with short, conical tubercles which make the galls appear superficially rougher than naked galls of *pezomachoides*, tho they are never as spiny as many of the galls of *pezomachoides;* light yellow and green to purplish pink when young, becoming straw yellow to dirty brown when old. Internally compact crystalline, the walls thick, flexible when moist, very hard when dry; the single larval cavity central, without a distinctive cell wall. Attached to the mid-veins or lateral veins, on either the upper or under sides of the leaves of the true white oaks, the chestnut oaks, and the Rocky Mountain white oaks (known from *Quercus macrocarpa, Q. bicolor, Q. Prinus, Q. Michauxii, Q. Gambelii,* and *Q. utahensis*).

RANGE.—Known from Massachusetts to Minnesota, Texas, and Utah. To be expected everywhere in the Rocky Mountain areas and the eastern United States and Canada, wherever white oaks occur. Figures 70-73.

The young galls of *Cynips hirta* are to be found early in July. The adults emerge from early in October to the middle of December, chiefly in the latter half of November. The alternate, bisexual generation is not recognized for any variety of this species. Judging from the experimentally demonstrated alternation of *Cynips pezomachoides* and the suggested alternate of *Cynips prinoides,* the two species most closely related to *hirta,* we may expect the alternate, bisexual generation of *hirta* in a simple, thin-walled cell in the buds of the oaks that harbor the agamic generation.

Altho not well represented in most collections, this insect has proved abundant in certain localities, and may be found more commonly upon further fieldwork. The gall is very similar to some of the more naked, nearly spineless galls of *Cynips pezomachoides,* but galls of four of the varieties of *hirta* are to be distinguished by their more ellipsoid form. The insects of *hirta* are readily separated from *pezomachoides* and *gemmula* because they have entirely hairy abdomens which usually are more compressed than in *gemmula* and not as greatly compressed as in *pezomachoides*.

Pezomachoides is restricted to the *Q. alba* and *gemmula* to the *Q. Prinus* groups of oaks. *Hirta* is known from both these

groups of oaks. On the true white oaks, *hirta* is known from four varieties on *Quercus macrocarpa* and two on *Q. Gambelii* and its varieties (including *Q. utahensis*) while gall material of an undescribed series in our collection was found on *Q. bicolor* (in Minnesota). *Hirta* is represented on the chestnut oaks by a variety that occurs on *Q. Prinus* and *Q. Michauxii.* While the inclusion of both true white and chestnut oaks by a single species of cynipid is not usual, neither is it uncommon, the situation being peculiar in this case because the commonest of the white oaks, *Q. alba* and *Q. stellata,* are not known as hosts of this insect.

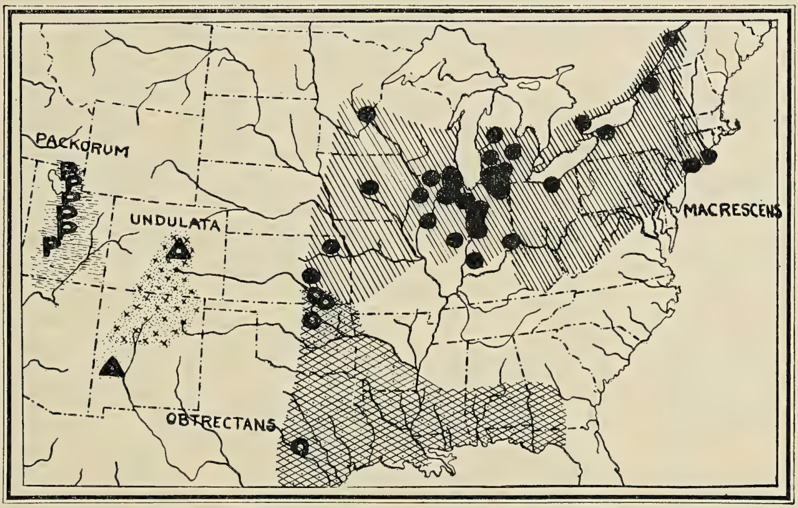

FIG. 70. FOUR VARIETIES OF CYNIPS HIRTA
Showing geographic isolation of related insects.

The seven varieties of *hirta* are hardly distinguishable from insects alone. The few insect characters available are, however, confirmed by the distinctive galls and host and geographic distribution of each variety. Varieties *scelesta, macrescens, obtrectans,* and *undulata* produce conspicuously ellipsoid galls, *scelesta* on *Q. macrocarpa* in sub-Canadian areas of the northeastern United States, *macrescens* on *Q. macrocarpa* in the northern Middle West, *obtrectans* (with a distinctive insect) on the same host in Oklahoma and Texas, and *undulata* on *Q. Gambelii* in the southern Rocky Mountain area. Varieties *hirta* and *opima* produce spheroidal galls, the first species on the eastern chestnut oaks, the second on *Q.*

macrocarpa in the more southern Middle West; variety *packorum* produces a spheroidal and rather roughly tuberculate gall on *Q. utahensis* in Utah. In spite of the close identities of the insects and the poor distinctions and confused synonomy of previous treatments of these particular cynipids, one may arrive at a clear-cut classification pregnant with biologic significance—if one will consider not only insect structure but all the other data which evidence the inherited constitution of these organisms.

Cosens has the following to say (1912, Trans. Canad. Inst. 9: 342) on the histologic structure of the gall of *macrescens* (mis-determined as variety *hirta*) of the present species:

> The anatomical structure of this gall differs from *P. erinacei* Beut. [see quotation under *erinacei*] only in the distribution and nature of the protective zone. This tissue is limited to a layer 3 to 4 cells in thickness, just outside the nutritive zone. The sclerifying deposits are limited almost entirely to the outside tangential walls of these cells and gradually entirely fill them. As a result of this the pores pass completely across the cells in the older stages. The small square crystal-bearing cells are, in this species, just outside the regular protective sheath.

Cynips hirta variety **undulata** (Gillette)

agamic form

Figures 70, 379, 423

Biorhiza hirta err. det. Ashmead, 1890, Colo. Biol. Assoc. Bull. 1: 38.

Acraspis undulata Gillette, 1893, Ent. News 4: 28. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 58. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 410, 817, 838. Thompson, 1915, Amer. Ins. Galls: 15, 36.

Acraspis macrocarpae err. syn. Beutenmüller, 1907 (in part), Bull. Amer. Mus. Nat. Hist. 23: 466.

Philonix macrocarpae err. syn. Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 251. Err. syn. Felt, 1918 (in part), N.Y. Mus. Bull. 200: 94. Err. syn. Weld, 1922 (in part), Proc. U.S. Nat. Mus. 61 (18): 10, 13.

Philonix hirta err. det. Beutenmüller, 1909 (Colo. record), Bull. Amer. Mus. Nat. Hist. 26: 250.

Philonyx hirta err. det. Beutenmüller in Smith, 1910 (*Q. undulata* record), Ins. N.J.: 598.

FEMALE.—Almost entirely deep rufo-piceous and black in color, the legs piceous black except for a little rufous at the tips of the coxae and at the joints of the tarsi; the antennae deep rufo-piceous, more

rufous basally; lateral lines indicated by smoother areas; wings 0.23 of the body in length; body 2.5 to 3.0 mm. in length. Figures 379, 423.

GALL.—Of moderate size, more or less ellipsoid, the faceted surface fairly smooth in appearance; on leaves of *Quercus Gambelii* and its varieties (NOT on *Q. undulata!*).

RANGE.—Colorado: Manitou (types, Gillette coll.).
New Mexico: Kingston (galls, Kinsey coll.).
Probably confined to *Q. Gambelii* and its varieties, in a Southern Rocky Mountain area of southern Colorado and more northern New Mexico. Figure 70.

TYPES.—19 females and numerous galls. Holotype and 4 paratype females and galls in the U.S. National Museum; paratype females and galls in the American Museum of Natural History and in the Illinois Natural History Survey collections.
The present re-descriptions are based on all this type material, the holotype and 5 of the paratypes being compared directly with paratypes of *macrocarpae* (= *macrescens*).

There appear to be no data on this insect beyond Gillette's record of the type collection. His galls, collected on June 30, contained mature adults that ran about when cut out. It is difficult to understand summer maturity, in the light of the data for related varieties of the species, unless these were survivors of the previous year's growth that had failed for some reason to emerge in the late fall or the winter. Gillette stated that from June 30 to November 19 none of the insects emerged, tho a number were cut out of the galls. His further statement that the galls were kept in a warm room after the last of September may offer one more explanation of the failure to obtain normal emergence.

I have a single gall from Kingston, New Mexico, which might well represent the present variety. The insect had emerged when I collected this gall on December 27 (1919). We must await insect material before we can be certain that *undulata* extends as far south as Kingston. West of the Rockies, in Utah, there occurs variety *packorum* with its distinctly blunt-spiny and spherical gall. True *undulata* does not occur east of Colorado.

Variety *undulata,* so named because of Gillette's confusion of the names of the Rocky Mountain oaks, really occurs on *Quercus Gambelii* and the closely related varieties or species of oaks. Fragments of leaves with the type material confirm our interpretation of the host.

Gillette described *undulata* by comparing it with *macrescens* (= Bassett's *macrocarpae*). Beutenmüller, examining paratypes of the two in 1907, failed to find these differences and considered the names synonymous. I agree with Beutenmüller that none of the characters noted by Gillette are reasonably appreciable or constant enough among the individuals of the type series to warrant taxonomic recognition. On the other hand, Beutenmüller, perhaps because he worked with a hand lens which would not show the diagnostic characters on the much reduced thoraces of these insects, failed to observe several distinctions which seem to me to be of significance. Other authors have followed Beutenmüller's synonomy without having examined material. Weld, whose 1922 revision of *Acraspis* was critical as far as it went, did have types of *undulata* but none of *macrescens* for comparison.

Undulata differs from *macrescens* chiefly in having more distinct lateral lines, more naked and shining areas on the mesopleuron, and wings that are (Gillette's original description to the contrary) a little longer than in *macrescens*. My measurements are made from camera lucida drawings of type material. The discovery of the bisexual generations of these insects may (or may not) offer further data for making distinctions, but the characters now recorded seem to warrant the recognition of these varieties with distinct geographic ranges and distinct hosts.

Cynips hirta variety **packorum,** new variety

agamic form

Figures 70, 317-318, 380, 424

FEMALE.—Almost entirely piceous black, the legs largely dark rufous to rufo-piceous; the antennae piceous black even basally; the lateral lines indicated as distinctly smoother areas; wings 0.28 of the body in length, longer than in the more eastern varieties (except *obtrectans*), reaching about a third of the way along the second abdominal segment; body 2.3 to 3.5 mm. in length. Figures 380, 424.

GALL.—Nearly spheroidal, moderately large, up to 6.0 mm. in diameter, with the faceted surface set with very short, cone-like projections, the gall consequently rough and short-spiny in appearance; on leaves of *Quercus utahensis*. Figures 317-318.

RANGE.—Utah: Wales and Central in Sevier County (galls, Hagen in Kinsey coll.). Salt Lake City (thru C. T. Dodds, in Kinsey coll.).

Payson, Bountiful (types), Centerville, Farmington, Layton, and Willard (B. and H. J. Pack in Kinsey coll.).

Probably confined to an area west of the Continental Divide.

TYPES.—30 females and many galls. Holotype and paratype females and galls in the Kinsey collection; paratype females and galls in the Museum of Comparative Zoology, the U.S. National Museum, and the American Museum of Natural History. Labelled Bountiful, Utah; galls September 10, 1927; insects December 18, 1927; *Q. utahensis;* B. and H. J. Pack collectors.

This insect is best distinguished from variety *undulata* and more eastern varieties of the species by its more generally black color (but more rufous legs), by its slightly longer wings, and particularly by its rougher and even spiny, spherical gall. The gall suggests a small gall of an agamic form of *Cynips gemmula* rather than the smooth, faceted galls of the other varieties of *hirta*. *Undulata* is probably confined to an area in southern Colorado and northern New Mexico *east* of the Continental Divide. The cynipid fauna of Utah is usually related to but never identical with this fauna from the eastern side of the Rockies.

How far *packorum* ranges in Utah is not determinable from our present insect material. Many Cynipidae in that state have more northern and more southern varieties whose ranges meet somewhere between Provo and Brigham. Most of our insect collections of *packorum* were made in this critical territory, but I cannot recognize two varieties in this material.

Most of our galls of this variety were gathered early in September, at which time they were still young enough to be touched with a rosy pink, but old enough to breed with fair success. Adult insects emerged (out-of-doors, at Bloomington, Indiana) on November 18 and December 10 and 20.

The type material and fine series of this variety from several other localities were collected by Dr. H. J. Pack, Entomologist of the Utah Agricultural Experiment Station, and his daughter Bessie Pack, for whom I am naming this insect. These collectors have sent me large series well representing the cynipid fauna of northeastern Utah, and they thus will contribute materially to our further revisions of the cynipid genera and our ultimate understanding of the distribution problems involved in that little-explored area west of the Continental Divide.

Cynips hirta variety **obtrectans,** new variety
agamic form

Figures 70, 381, 425

FEMALE.—Color bright brownish rufous, the antennae also brownish rufous, darker only toward the tips; bright yellow-rufous on most of the mesonotum, on most of the second abdominal segment, and on other large areas on the abdomen postero-ventrally; lateral lines practically absent; abdomen relatively larger than in *macrescens;* wings 0.35 of the body in length, extending fully one-half of the way along the second abdominal segment; 2.2 to 3.5 mm. in length, normally larger than *macrescens.* Figures 381, 425.

GALL.—More ellipsoid than spheroidal; up to 5.5 mm. in length; the faceted surface distinctly smooth in appearance; on leaves of *Quercus macrocarpa.*

RANGE.—Texas: Austin (types; Patterson coll.).
Oklahoma: Pawnee. (Kinsey coll.).
Kansas: Winfield and 10 miles southeast of Winfield (galls, R. Voris in Kinsey coll.).
Probably confined to eastern Texas and Oklahoma, or perhaps extending due east from that area as far as the host, *Q. macrocarpa,* occurs. Figure 70.

TYPES.—2 females and 3 galls in the Kinsey collection. Labelled Austin, Texas; insects cut out of galls October 26, 1921; *Q. macrocarpa;* J. T. Patterson collection number 136.

This is the more southern of the burr oak varieties of *hirta.* The present insect is distinct enough from the more northern varieties *macrescens, scelesta,* and *opima,* to allow certain determination. I have only one immature adult from the material I collected in 1920 at Pawnee, Oklahoma, but it shows the coloration and the lengthened wings of the types from Austin, Texas, and I take it that the range of the variety is largely east and northeast from Austin.

Dr. Ralph Voris has collected young but full-sized galls, of this species but doubtfully of this variety, in southeastern Kansas as early as June 6, 1927. At that time the larvae were still microscopic in size. Dr. Patterson collected the type galls in the fall of 1921, cutting two mature (one not fully pigmented) and live adults from the galls on October 26 of the same year.

Cynips hirta variety **opima**, new variety
agamic form

Figures 71, 382, 426

FEMALE.—Rufo-piceous and black, often with the mesonotum largely rufous, the antennae almost entirely black; lateral lines practically absent; wings averaging about 0.26 of the body in length; rather large and distinctly robust insects with much-swollen abdomens, the body 2.7 to 3.8 mm. in length. Figures 382, 426.

GALL.—Nearly spheroidal, slightly ellipsoid; up to 3.5 mm. in diameter; the surface fairly smooth; on leaves of *Quercus macrocarpa.*

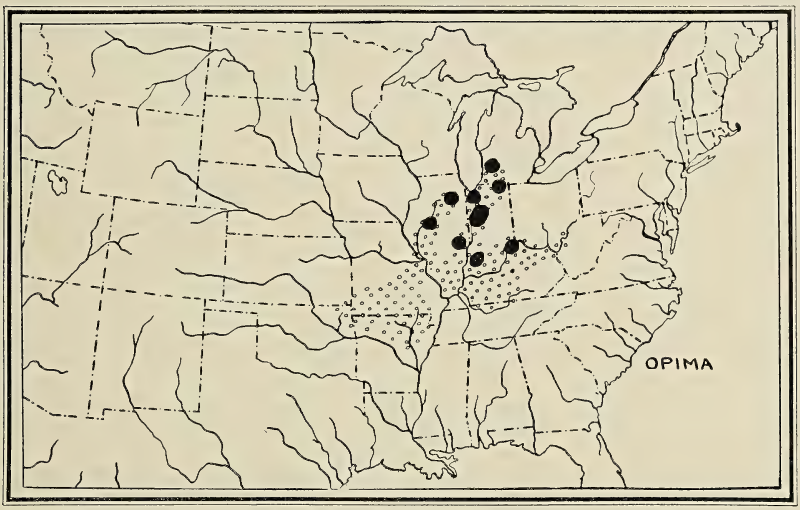

FIG. 71. OZARK VARIETY OF CYNIPS HIRTA
Possible extension of known range shown by shading.

RANGE.—Michigan: Wayland.

Illinois: Seneca (types, Kinsey coll.). Charleston and Green Valley in Tazewell County (Kinsey coll.).

Indiana: Mongo, Delphi, Romney, Morocco, Rogers in Pike County, and Aurora (Kinsey coll.).

Centering in more southern Indiana, Illinois, and possibly southwestward into the Ozarks; found northward into Michigan only within populations of the hybrid variety *macrescens*. Figure 71.

TYPES.—55 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the Museum of Comparative Zoölogy, the U.S. National Museum, the American Museum of Natural History, and the California Academy. Labelled Seneca, Illinois; galls October 13, 1928; insects December 12 and 20, 1928; *Q. macrocarpa;* Kinsey collector.

This is the more southern variety of *hirta* in the northern Middle West, occurring in Indiana and Illinois where we might expect an Ozark variety, altho we do not have collections of the species from localities within the Ozarks proper. This appears to be the form which, hybridizing with the northern *scelesta,* gave rise to the hybrid variety *macrescens,* and segregates of *opima* consequently occur on occasion as far north as *macrescens* extends. Quite different are the nearly pure populations of *opima* in Illinois and southern Indiana. Both insects and galls of typical *opima* are about as distinct from *scelesta* as anything in the present species; but the occurrence of the hybrid *macrescens* in between provides such a gradation from *opima* to *scelesta* that determinations of anything less than large series of these insects cannot be more than approximations to natural interpretations.

Our emergence records for this insect are November 4, 16, 19, and 20, and December 1, 4, 8, 12, 15, 18, 19, 20, 22, and 28.

Cynips hirta variety **scelesta,** new variety

agamic form

Figures 72, 383, 427

FEMALE.—Almost entirely brownish-piceous and black, the antennae brown basally; lateral lines absent; wings reduced to stubs 0.21 of the body in length; the abdomen with only scattered hairs on the segments posterior to the second; body 1.5 to 2.5 mm. in length, the insect very small and slender with a very much reduced thorax and compressed abdomen. Figures 383, 427.

GALL.—Always elongate ellipsoid; up to 4.0 mm. in length; the faceted surface quite smooth in appearance; on leaves of *Quercus macrocarpa.*

RANGE.—Michigan: Wayland (types, Kinsey coll.) Big Rapids and Tekonshah (Kinsey coll.).

Indiana: Morocco, Romney, Delphi, and Mongo (Kinsey coll.).

Illinois: Seneca (Kinsey coll.).

Centering on the very northern rim of the range of *Q. macrocarpa,* probably from New York to Minnesota. Remnants of the species scattered southward (by the Pleistocene glaciation) thruout Indiana and Illinois. Figure 72.

TYPES.—144 females and many galls. Holotype and paratype females and galls in the Kinsey collection. Paratype females and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, the U.S. National Museum, and the California Academy. Labelled Wayland, Michigan; galls October 5, 1927; insects November 20 and December 8, 1927; *Q. macrocarpa;* Kinsey collector. Individuals

intermediate between *scelesta* and *macrescens* occur in the same locality. The holotype is one of the smallest and most uniformly piceous of the type series.

This is the sub-Canadian variety of the species; to be expected everywhere on the most northern rim of the range of *Quercus macrocarpa.* The extreme form of the insect is distinguished more readily than any of the other eastern varieties of *hirta.* On the other hand, the hybrid of *scelesta* and *opima* is the widespread *macrescens,* and thruout more southern Michigan every transition occurs between *scelesta* and *macrescens,* while further south *scelesta* appears here and there as a segregate in the hybrid population. Since the host, *Q. macrocarpa,* does not extend into the true Canadian zone, it is

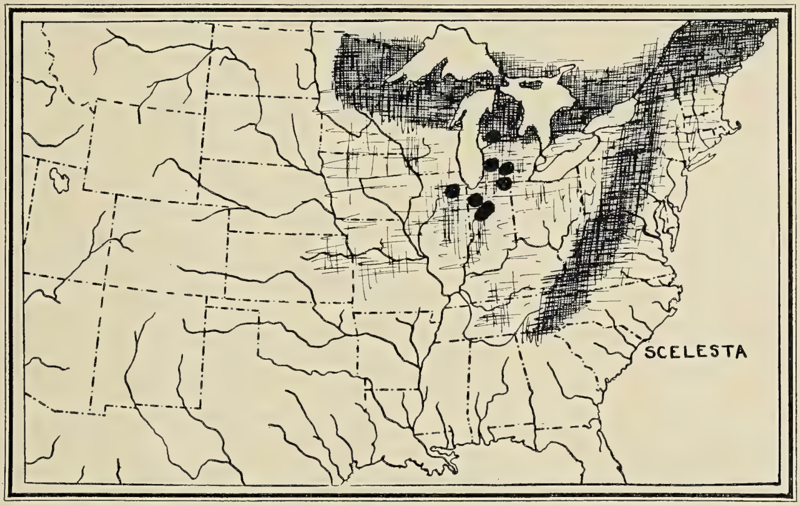

FIG. 72. NORTHERN VARIETY OF CYNIPS HIRTA

possible that a pure population of *scelesta* has not been maintained north of the area of hybridization.

Our emergence dates for this insect are November 20 and December 1, 4, 8, 12, 15, and 22.

Cynips hirta variety **macrescens,** new name

(= *C. hirta scelesta x opima?*)

agamic form

Figures 70, 316, 329, 384, 428.

Biorhiza macrocarpae Gillette, 1889, Psyche 5: 221 [credited to Bassett; without description].

Acraspis macrocarpae Bassett, 1890, Trans. Amer. Ent. Soc. 17:84.

Gillette, 1892, Proc. Iowa Acad. Sci. 1 (2): 113. Gillette, 1893, Ent. News 4: 28, 29. Dalla Torre, 1893, Cat. Hymen. 2: 64. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip. 58. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 25. Jarvis, 1907, Rpt. Ent. Soc. Ont. 37: 69. Beutenmüller, 1907 (in part), Bull. Amer. Mus. Nat. Hist. 23: 466. Jarvis, 1909 Rpt. Ent. Soc. Ont. 40: 86. Dalla Torre and Kieffer, 1910, Das Tierreich 24: 410, 817. Thompson, 1915, Amer. Ins. Galls: 15, 36. Weld, 1922 (in part), Proc. U.S. Nat. Mus. 61 (18): 10. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 200. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 58. Weld in Leonard, 1928, Ins. N.Y.: 970.

Philonix macrocarpae Ashmead in Smith, 1900, Cat. Ins. N.J.: 548. Felt, 1906, Ins. Aff. Pk. & Woodl. Trees: 713. Beutenmüller, 1909 (in part), Bull. Amer. Mus. Nat. Hist. 26: 251, pl. 43 fig. 11. Viereck, 1916, Hymen. Conn.: 382. Felt, 1918 (in part), N.Y. Mus. Bull. 200: 94, fig. 89 (11).

Philonyx macrocarpae Beutenmüller in Smith, 1910 (in part), Ins. N.J.: 598.

Philonix hirta err. det. Cosens, 1912, Trans. Canad. Inst. 9: 342. Err. det. Felt, 1921, N.Y. Mus. Bull. 231-232: 73.

Acraspis macrocarpa Weld, 1922 (in part), Proc. U.S. Nat. Mus. 61 (18): 13.

[NOT *Diplolepis q. macrocarpae* Karsch, published as *Cynips macrocarpae* by Dalla Torre, 1893, Cat. Hymen. 2: 73.]

[*Acraspis macrocarpae* and *Philonix macrocarpae* of Beutenmüller, Felt, and Weld papers, 1907 to date, apply in part to variety *undulata* (Gillette).]

FEMALE.—A variable insect, deep rufous, rufo-piceous, and black to entirely black in color, the antennae similarly dark rufo-piceous and black; lateral lines practically absent; wings reduced to stubs 0.21 of the body in length; body 2.5 to 3.5 mm. in length, the insect larger and more robust than variety *scelesta,* smaller and less robust than *opima.* Figures 384, 428.

GALL.—Usually elongate ellipsoid; up to 4.0 mm. in length; the faceted surface hardly with projecting tips and consequently fairly smooth in appearance; on leaves of *Quercus macrocarpa.* Figures 316, 329.

RANGE.—Quebec: Dows Lake (gall, Rowland in Gray Herb.).

Ontario: province (acc. Jarvis 1907). Toronto (Brodie in U.S. Nat. Mus.).

New York: Medina (acc. Weld 1926). St. Lawrence County (acc. Bassett 1890). Manorville (?) and Farmingdale (?) (acc. Weld 1928).

Ohio: Rockport (types; Bassett).

Indiana: Delphi, Steubenville, Mongo, Romney, Morocco, Aurora, Clinton, and Rogers in Pike County (Kinsey coll.). Auburn (gall, Kinsey coll.). Roachdale (gall, G. Blaydes in Kinsey coll.).

Michigan: Lansing (acc. Gillette). Tekonsha, Wayland, Owosso, and Three Rivers (Kinsey coll.).

Illinois: Evanston, Winnetka, Libertyville, Glen Ellyn, and Moline

(acc. Weld 1926). Fountaindale (acc. Weld 1926; also gall, Bebb in Gray Herb.). Charleston, Green Valley in Tazewell County, and Seneca (Kinsey coll.).

Minnesota: Hastings Road (gall, Ruggles acc. Felt 1921). Minneapolis (galls, J. S. Benner in Kinsey coll.).

Iowa: Ames (Gillette in Ill. Lab. and U.S. Nat. Mus.). "Keosauqua" (?) (gall, MacDonald in Gray Herb.). Corinth (gall, C. Barracks acc. Weld 1926).

Kansas: Cedar Point and Holton (galls, acc. Weld 1926).

Probably confined to a more northern range of the host, *Q. macrocarpa,* from Quebec to Minnesota and Kansas. Replaced on the extreme northern limits of the range of the host by variety *scelesta.* The more western records need re-determination; the published Colorado records apply to variety *undulata.* Figure 70.

TYPES (of *macrocarpae*).—Holotype and 6 paratype females and galls in the Philadelphia Academy. Paratype females and galls in the American Museum of Natural History and in the Kinsey collections; paratype galls in the U.S. National Museum. From Rockport, Ohio; *Quercus macrocarpa;* Bassett collection. Now designated as types for the new name *macrescens.*

The present re-descriptions are based on all of this type material compared with Middle-Western material. The type insects have faded to a brighter rufo-piceous than the original description and fresh specimens show to be characteristic of the variety.

This is the common, nearly spineless, *Acraspis* gall on the burr oak in the more northern Middle West, but not on the very northern rim of the range of *Q. macrocarpa.* It is unfortunate that Bassett's well-known name, *macrocarpae,* for this insect is already pre-occupied in *Cynips* (as indicated in the synonomy above), and that it is necessary to introduce the new name *macrescens* for this insect.

Macrescens shows the considerable variation which is evident in northern Middle-Western varieties of *Cynips fulvicollis* and *C. pezomachoides.* Toward the north *macrescens* averages smaller and darker, finally giving way in north-central Michigan to the variety *scelesta.* In southern Indiana and Illinois, and thru parts of more northern Illinois *macrescens* averages larger and more robust and gives way to purer populations of variety *opima.* These three insects are not differentiated by many characters, probably because of the great simplicity of structure of all the sub-apterous Cynipidae; but their distinction is important because of the light it throws on the origin of a species by the hybridization of more northern and more southern varieties which were brought together during the glacial invasions of the Pleistocene. Thruout the

range of *macrescens* individuals may be found with the characters of pure *scelesta* or *opima,* but the mass of the population of *macrescens* represents an intermediate blending of the parental characters. Variable and poorly fused as this aggregate may be, I feel we should continue to recognize it as a taxonomic unit deserving a name for convenience of reference.

The galls of *scelesta* are ellipsoidal, those of *opima* more nearly (but not quite) spheroidal. In the galls of *macrescens* the *scelesta* influence usually dominates, but there is some variation in this gall character.

Felt recorded young galls of this variety (misdetermined as *hirta*) from Minnesota as early as July 23. Weld found pupae in galls from northern Illinois early in September. Galls which I collected at Delphi in northern Indiana on September 21 (1926) were just beginning to drop to the ground. Many of them at that time showed exit holes which indicated the emergence of parasites. The cynipids were still larvae in the galls on that date. Weld cut living adults from his Illinois material as early as the last week of September. Normal emergence dates are recorded as follows: October 10 (acc. Gillette 1889); November 4 and 10 (Kinsey in 1926); November 9 to 14 (Brodie in U.S. Nat. Mus.; in 1885 and 1893); November 14 (acc. Weld 1926); November 15 to 30 (Brodie in U.S. Nat. Mus.; in 1892); November 4, 16, 19, 20, and December 1, 4, 8, 12, 15, 18, 20, 22, and 28 (Kinsey 1926 to 1928). While the major part of the large series of material I have bred emerged in the first half of November, it will be seen that many of the insects emerged after December 1 and even as late as December 28. All of the adults had previously emerged from galls collected at Roachdale, Indiana, on December 26 (in 1922). Some of the many parasites that are to be found in these galls emerge before the gall makers in the fall, but the majority of the parasites and inquilines do not mature until the following May or June.

Cynips hirta variety **hirta** Bassett

agamic form

Figures 73, 321-322, 385, 429

Cynips q. hirta Bassett, 1864, Proc. Ent. Soc. Phila. 3: 688.
Cynips hirta Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 340, 347, 353, 359, 378. Bassett, 1870, Trans. Ent. Soc. London: XV. Bassett, 1870, The Ent. 5: 111. Cresson, 1923, Trans. Amer. Ent. Soc. 48: 199.

Cynips (Teras) hirta Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 333, 379. Packard, 1881, U.S. Ent. Comm. Bull. 7: 56.

Q. hirta Walsh, 1870, Amer. Ent. and Bot. 2: 299.

Biorhiza hirta Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 296. Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127. Cresson, 1887, Trans. Amer. Ent. Soc. 14: suppl. 178. Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 106, 110. Beutenmüller, 1892, Bull. Amer. Mus. Nat. Hist. 4: 260. Bridewell, 1899, Trans. Kans. Acad. Sci. 16: 204. Beutenmüller, 1904, Bull. Amer. Mus. Nat. Hist. 20: 25. Felt, 1906, N.Y. Mus. Memoir 8(2): 712. Thompson, 1915, Amer. Ins. Galls: 15, 36. Viereck, 1916, Hymen. Conn.: 383.

Biorrhiza hirta Dalla Torre, 1893, Cat. Hymen. 2:60. Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 56.

Philonix hirta Ashmead in Smith, 1900, Cat. Ins. N.J.: 548. Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 250, pl. 43 fig. 10. Felt, 1918, N.Y. Mus. Bull. 200: 94, fig. 89 (10).

Philonyx hirta Beutenmüller in Smith, 1910, Ins. N.J.: 598.

Trichoteras quercus-hirtum Dalla Torre and Kieffer, 1910, Das Tierreich 24: 404, 821, 836.

Philonix pezamachoides err. det. Felt in Thompson, 1915, Amer. Ins. Galls: 61.

Biorhiza (Xystoteras) hirta Britton, 1920, Checklist Ins. Conn.: 319.

Acraspis hirta Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 10, 13. Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 58. Weld in Leonard, 1928, Ins. N.Y.: 970.

[Ashmead's and Beutenmüller's Colorado records of *hirta* apply to variety *undulata*. Cosens' and Felt's records of *hirta* on *Q. macrocarpa* apply to variety *macrescens*.]

FEMALE.—Almost entirely deep rufo-piceous and black, the antennae entirely deep rufo-piceous; lateral lines practically absent; wings 0.23 of the body in length; body 2.7 to 3.7 mm. in length. Figures 385, 429.

GALL.—Quite spheroidal, moderately large, up to 6.0 mm. in diameter; the faceted surface without projecting spines and consequently smooth in appearance; on leaves of *Quercus montana* (= *Q. Prinus* = *Q. monticola* of authors), *Q. Michauxii,* and probably related chestnut oaks. Figures 321-322.

RANGE.—Toronto (Brodie in U.S. Nat. Mus.).

Massachusetts: Worcester? (gall, M. T. Thompson in Boston Soc.).

Connecticut: Waterbury (types; Bassett coll.).

New York: West Point (Bassett in Mus. Comp. Zoöl.). Storm King (gall, M. D. Leonard acc. Weld 1926). Highbridge (gall, Amer. Mus. coll.). Huntington (J. C. Bridewell in U.S. Nat. Mus.). Ithaca (gall, acc. Weld 1926).

New Jersey: Fort Lee (gall, acc. Beutenmüller 1910). Richland (gall, Kinsey coll.).

Pennsylvania: Washingtonville (gall, E. C. Zeliff in Kinsey coll.).

D.C. (acc. Beutenmüller 1909).

Virginia: Bluemont (gall, acc. Weld 1926). Blue Ridge Mountains

near Natural Bridge Station (gall, Kinsey coll.). Winchester (Kinsey coll.).

North Carolina: Asheville (Ashmead in U.S. Nat. Mus.).

Kentucky: Livingston (gall, *Q. Michauxii,* Kinsey coll.).

Indiana: Nashville (*Q. Michauxii,* Kinsey coll.).

Michigan: Agricultural College (Gillette? in U.S. Nat. Mus.).

Kansas: state (acc. Bridewell 1899). St. George (in U.S. Nat. Mus.).

Probably confined to the chestnut oaks in a more northeastern area of the United States and Canada, at least from Connecticut to Indiana, perhaps westward to Missouri. The Atlantic Coastal Plain, the more southern, and the most western records given above need further examination when the bisexual adults become known. Figure 73.

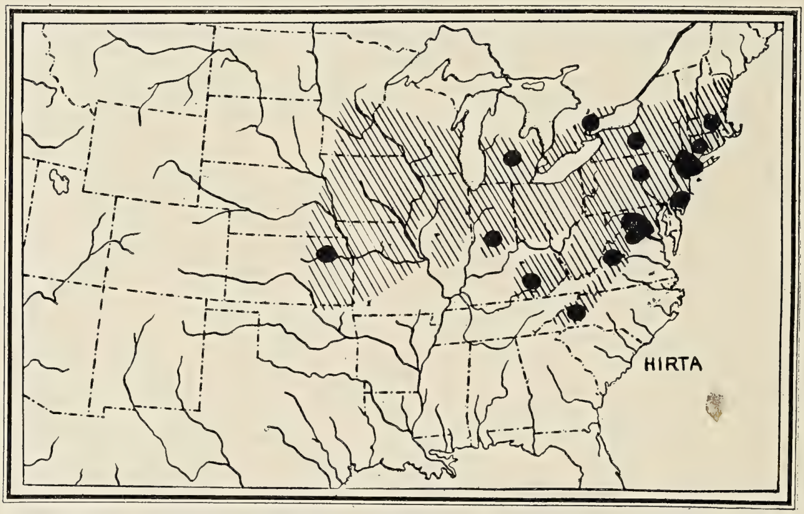

FIG. 73. CYNIPS HIRTA VARIETY ON CHESTNUT OAKS

TYPES.—6 females, a number of galls, and other specimens not distinguished from the true types in Bassett's collection. Holotype and 5 paratype females and galls in the Philadelphia Academy; paratype insects and galls in the American Museum of Natural History, the Museum of Comparative Zoölogy, and the U.S. National Museum; paratype galls in the Kinsey collection. From Waterbury, Connecticut; October; *Q. montana* (= *Q. Prinus* of authors); H. F. Bassett collector.

The present re-descriptions are based on the holotype and most of the paratype material.

PARASITES.—*Eurytoma auriceps* Walsh (acc. Walsh 1870).
E. studiosa Say (acc. Walsh 1870).

This is the chestnut oak variety of the species, originally described from *Q. Prinus* and now recorded from *Q. Michauxii.*

Most of the Cynipidae do not make distinctions between the several species of Middle-Western chestnut oaks. Beutenmüller's 1900 record (in Ashmead in Smith (1900: 548)), and Viereck's 1916 records of *Q. ilicifolia* as the host are certainly errors, while the *Q. macrocarpa* records should apply to variety *macrescens*.

Mature galls of this variety in the American Museum are dated September 11 (1904). Bassett collected galls in October, finding that the insects had begun to eat passages thru the walls of the galls on October 20, altho the first emergence occurred on November 29. Galls I collected in Virginia on October 18 (1919) showed exit holes, but whether of gall makers, inquilines, or parasites, I cannot determine. An adult gall maker was alive in a gall I collected on October 31 (in 1920) at Nashville, Indiana. I have bred adults on December 20 and January 5 (1928). Bassett (1870) notes that the peculiar, acid odor characteristic of several short-winged cynipids is found in *hirta*.

This insect is very close to variety *macrescens* from which it appears to be distinguished only by the longer wings and by the large, spherical gall. From variety *undulata, hirta* appears to differ in having the antennae darker at base, the lateral lines absent, and the mesopleura more hairy. But altho I have examined the holotypes of all of these insects, and made direct comparisons of paratypes of the three, I am not certain that I could determine additional insect material without locality records or galls. On the other hand, the galls of the three are so distinct that, with the additional host and geographic peculiarities of each, the varieties should be maintained as distinct. The much reduced thorax and the mere stubs of wings which these forms of *Acraspis* show offer very few characters for taxonomic determinations. The characters given for these agamic insects by Weld (1922) in his key to *Acraspis* did not seem to me to separate the paratypes of the several varieties when I studied them at Washington a couple of years ago.

APPENDICES

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NAMES PRE-OCCUPIED IN CYNIPS

THE citations given are for the earliest combination of each name with *Cynips* in the literature available during the preparation of this paper. Inasmuch as most of the older authors considered all Cynipidae—and in some cases all insects bred from galls—as belonging to the genus *Cynips,* there are undoubtedly additional names to be added to this list. For this reason, in the publication of new specific names in *Cynips,* it will be wise to avoid all names that have ever been used in the family Cynipidae. Names applied to galls only, or such combinations with *Cynips* as antedate the description of the insect itself, have not been considered to have nomenclatorial standing and are not included in this list. Thruout these references, Dalla Torre, 1893, Catalogus Hymenopterorum, volume 2 (Cynipidae), is abbreviated to D.T. 93: ——. Dalla Torre and Kieffer, 1910, Das Tierreich 24:, is abbreviated to D.T. & K. 10: ——.

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Acaciae-longifoliae Froggatt, 1892, Proc. Linn. Soc. N. S. Wales (2) 7: 154.

Aceris Gmelin, 1790, Syst. Nat. 1 (5): 2652 (acc. D.T. 93: 131).

Aceris-campestris Huber, 1807, Vollst. Naturg. Bau- und Baumhölzer 2 (6): 285 (acc. D.T. 93: 65).

Aciculata Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 56.

Acraspiformis Weld. Present assignment.

Advena Kinsey. Present assignment.

Aestivalis Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 67 (acc. D.T. 93: 79).

Affinis Bassett, 1881, Canad. Ent. 13: 103.

Agama Hartig, 1840, Germar Ent. Zeit. 2: 188, 197, 198.

Agrifoliae Bassett, 1881, Canad. Ent. 13: 53.

Alaria Weld. Present assignment.

Albicolens Kinsey. Present assignment.

Albipes Schenck, by Kaltenbach, 1874, Pflanzenfeinde: 674, 793.

Albipuncta Kaltenbach, 1874, Pflanzenfeinde: 674, 793.

Albopunctata Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 376 (acc. D.T. 93: 79).

Ambigua Trotter, 1899, Riv. Pat. Veg. 7: 300 (acc. D.T. and K. 10: 421).

Amblycera Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 347.

Amenti Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 69 (acc. D.T. 93: 80).

Amentorum Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T.93: 97).
Amerinae Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Amygdali Buckton, 1879, Monog. Brit. Aphid. 2: 150, pl. 73 fig. 6 (acc. D.T. and K. 10: 288).
Analis Fonscolombe, by D.T.93: 65.
Anceps Kinsey. Present assignment.
Anthracina Curtis, 1838, Brit. Ent. 15: 688.
Apache Kinsey. Present assignment.
Aprilinus Giraud, by Kaltenbach, 1874, Pflanzenfeinde: 673, 793.
Aptera Bosc, 1791, Bull. Soc. Philom. Paris 2: 18 (acc. D.T.93: 59).
Aquaticae Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVI.
Arbos Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 809.
Argentea Hartig, 1843, Germar Ent. Zeit. 4: 401.
Arida Kinsey. Present assignment.
Aries Wachtl, 1876, Sprawozd. Komisyi. Fizyogr. Krakowie 10: 19, 27 (acc. D.T.93: 66).
Armatus Cresson, 1865, Proc. Ent. Soc. Phila. 4: 4.
Ashmeadi Dalla Torre and Kieffer, 1910, Das Tierreich 24: 440.
Atra Müller, 1764, Fauna Ins. Fridrichsdal: 68 (acc. D.T.93: 66).
Atrata Kinsey. Present assignment.
Atriceps Buckton, 1879, Monog. Brit. Aphid. 2:150 (acc. D.T.93: 66).
Atridivisa Kinsey. Present assignment.
Atrifolii Kinsey. Present assignment.
Attenuata Latreille, 1805, Hist. Crust. & Ins. 13: 223 (acc. D.T.93: 66).
Aurata Müller, 1764, Fauna Ins. Fridrichsdal: 68 (acc. D.T.93: 66).
Autumnalis Hartig, 1841, Germar Ent. Zeit. 3: 336.

Baccarum Linnaeus, 1758, Syst. Nat. ed. 10, 1: 553.
Batatoides Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XI.
Batatus Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 810.
Bella Bassett, 1881, Canad. Ent. 13: 93.
Bicolens Kinsey. Present assignment.
Bicolor Harris, 1841, Ins. Mass. Inj. Veget.: 399.
Bifurca Kinsey. Present assignment.
Bimaculata Schenck, 1865, Jahrb. Ver. Nassau 17-18: 178, 185.
Bombycida Rondani, 1877, Bull. Soc. Ent. Ital. 9: 172, pl. 4 fig. 138, 139 (acc. D.T. & K. 10: 443).
Brachycentra Thomson, 1877, Opusc. Ent. 8: 788.
Brandtii Ratzeburg, 1831, Berliner Jahrb. Pharm. 32: 183 (acc. D.T. 93: 117).
Brevipennata Gillette. Present assignment.
Burgundus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 68 (acc. D.T.93: 81).

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Calicis Burgsdorf, 1783, Schrift. Berlin. Ges. naturf. Fr. 4: 5 (acc. D.T. 93: 66).
Californicus Bassett, 1881, Canad. Ent. 13: 51.
Callidoma Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 348.

Callidoma Thomson, 1877, Opus. Ent. 8: 784.
Calvescens Kinsey. Present assignment.
Campestris Huber, 1807, Vollst. Naturg. Bau- und Baumhölzer 2: 285 (acc. D.T.93: 65).
Canadensis Kinsey. Present assignment.
Canescens Bassett, by Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 342.
Capreae Linnaeus, 1767, Syst. Nat. ed. 12, 1 (2): 919.
Capsuala Ashmead, 1885, Trans. Amer. Ent. Soc. 12: IX.
Capsula Bassett, 1881, Canad. Ent. 13: 101.
Caput-medusae Hartig, 1843, Germar Ent. Zeit. 4: 401.
Cardui Müller, 1764, Fauna Ins. Fridrichsdal: 68 (acc. D.T.93: 67).
Carnifex Hartig, 1843, Germar Ent. Zeit. 4: 406.
Carolina Ashmead. Present assignment.
Catesbaei Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XV.
Cava Weld. Present assignment.
Centaureae Förster, by Kaltenbach, 1874, Pflanzenfeinde :386.
Centricola Osten Sacken, 1861, Proc. Ent. Soc. Amer. 1: 53, 58.
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Cerriphilus Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 354.
Championi Ashmead, 1899, Ent. News 10: 194, 195.
Chrysolepidicola Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 124.
Cicatricula Bassett, 1881, Canad. Ent. 13: 101, 113.
Cincturata Kinsey. Present assignment.
Cinerea Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XIX.
Cinerosa Bassett, 1881, Canad. Ent. 13: 110.
Citriformis Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XXVIII.
Clavicornis Hartig, by Kaltenbach, 1874, Pflanzenfeinde: 669.
Clavigera Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XXVII. Also as *claviger*.
Clavula Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 351.
Clavuloides Kinsey. Present assignment.
Clementinae Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 349.
Clivorum Kinsey. Present assignment.
Cocciniae Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 243, 247.
Coelebs Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 61.
Collaris Hartig, 1840, Germar Ent. Zeit. 2: 190.
Compressa Fabricius, 1798, Suppl. Ent. Syst.: 213.
Compta Kinsey. Present assignment.
Concolor Kinsey. Present assignment.
Confluentus Harris, 1841, Ins. Mass. Inj. Veget. :397.
Confusa Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVIII.
Congesta Kinsey. Present assignment.
Conglomerata Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 344.
Conica Kinsey. Present assignment.
Conifera Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XXVII.
Conifica Hartig, 1843, Germar Ent. Zeit. 4: 402.

Consobrina Zetterstedt, 1838, Ins. Lappon. 1: 410 (acc. D.T.93: 68).
Consocians Kinsey. Present assignment.
Conspicua Kinsey. Present assignment.
Corallina Bassett, by Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 343.
Coriaria Haimhoffen, 1867, Verh. zoo.-bot. Ges. Wien 17: 527.
Cornifex Hartig, 1843, Germar Ent. Zeit. 4: 406 (as *Cynips carnifex*).
Cornigera Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 358.
Coronaria Stefani, 1898, Natural. Sicil. (2) 2: 160 (acc. D.T. & K. 10: 431).
Coronata Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 343.
Corrugis Bassett, 1881, Canad. Ent. 13: 109.
Corruptrix Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 339.
Corticalis Hartig, 1840, Germar Ent. Zeit. 2: 190.
Corticis Hartig, 1840, Germar Ent. Zeit. 2: 190.
Coxii Bassett, 1881, Canad. Ent. 13: 112.
Crassicornis Curtis, 1838, Brit. Ent. 15: 688.
Crassior Kinsey. Present assignment.
Crassitelus Provancher, 1881, Nat. Canad. 12: 232.
Cristatae Henschel, 1876, Leitfad. Best. Schädl. Inset. :225 (acc. D.T. 93: 67).
Cruenta Kinsey. Present assignment.
Crustalis Hartig, by Kaltenbach, Verh. Ver. Rheinl. 24: 57 (acc. D.T. 93: 62).
Cultellator Fabricius, by Jurine, 1807, Nouv. méth. class. Hymén. :286 (acc. D.T.93: 132).
Curtisii Müller, 1870, Gard. Chron. 40: 1312 (acc. D.T.93: 68).
Curvator Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T.93: 85).
Cydoniae Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 68 (acc. D.T.93: 85).

Dalmanni Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 No. 39.
Decidua Beutenmüller, 1913, by Felt, 1918, N.Y. Mus. Bull. 200: 110, pl. 3 fig. 1. *Cynips decidua* for gall only by Bassett, 1864, Proc. Ent. Soc. Phila. 3: 689.
Derivatus Kinsey. Present assignment.
Dichlocerus Harris, 1841, Ins. Mass. Inj. Veget.: 399.
Dimorphus Beutenmüller, 1913, Trans. Amer. Ent. Soc. 39: 245.
Discoloris Froggatt, 1892, Proc. Linn. Soc. N.S. Wales (2) 7: 153.
Disticha Hartig, 1840, Germar Ent. Zeit. 2: 188.
Distigma Taschenberg, 1866, Hymen. Deutschl.: 144.
Divisa Hartig, 1840, Germar Ent. Zeit. 2: 188.
Douglasii Ashmead. Present assignment.
Dugèsi Mayr. Present assignment.
Dumosae Kinsey. Present assignment.
Duricoria Bassett, by Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 113.

Echinoides Kinsey. Present assignment.
Echinus Osten Sacken, 1870, Trans. Amer. Ent. Soc. 3: 56.

Ediogaster Rossi, by Rossi, 1794, Mant. Ins. 2: pl. 6 fig. E (acc. D.T. 93: 9).
Equiseti-arvensis Ström, 1788, Danske Vid. Selsk. Skrift. Nya Saml. 3: (acc. D.T. 93: 68).
Erinacei Beutenmüller. Present assignment. Applied to gall only by Dalla Torre, 1898, Cat. Hymen. 5: 329.
Erythrocephala Jurine, 1807, Nouv. Méth. Class. Hymén.: 286 (acc. D.T. 93: 69).
Erythrocephalus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 67 (acc. D.T.93: 85).
Eucharioides Dalman, 1818, Svensk. Akad. Handl. 39: 78 (acc. D.T.93: 12).
Expositor Kinsey. Present assignment.

Fecundatrix Hartig, 1840, Germar Ent. Zeit. 2: 189. Also as *foecundatrix.*
Ferruginea Hartig, 1840, Germar Ent. Zeit. 2: 189.
Ficigera Ashmead, 1885, Trans. Amer. Ent. Soc. 12: VI.
Ficula Bassett, 1881, Canad. Ent. 13: 75.
Ficus Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 813.
Flava Goureau, 1851, Ann. Soc. Ent. France 1851: 168.
Flavicollis Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 123.
Flavipes Fonscolombe, by D.T.93: 69.
Flocci Walsh, 1864, Proc. Ent. Soc. Phila. 2: 464, 482.
Floccosa Bassett, 1881, Canad. Ent. 13: 111.
Flosculi Giraud. Present assignment.
Foliata Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XIII.
Folii Linnaeus 1758, Syst. Nat. ed. 10, 1: 553.
Formosa Bassett, 1864, Proc. Ent. Soc. Phila. 3: 679.
Forsiusi Kinsey. Present assignment.
Forticornis Walsh, 1864, Proc. Ent. Soc. Phila. 2: 464, 490.
Fortii Trotter, 1907, Marcellia 6: 13.
Fuliginosa Ashmead, 1885, Trans. Amer. Ent. Soc. 12: VII.
Fulviceps Curtis, 1838, Brit. Ent.: 688.
Fulvicollis Fitch, by Osten Sacken, 1865, Trans. Ent. Soc. Phila. 4: 379.
Fumipennis Hartig, by Thomson, 1877, Opusc. Entom. 8: 789.
Fuscata Kinsey. Present assignment.
Fusiformis Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 53, 61.
Futilis Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 51, 64.

Galeata Mayr, 1870, Mitteleurop. Eichen-gallen: 22.
Gallae-cerasiformis D'Anthoine, 1794, Nouv. Journ. Phys. 1: 38, fig. 10 (acc. Kieffer, 1898, Wiener Ent. Zeit. 17: 265).
Gallae-cristatae Henschel, 1876, Leitfad. Best. Schädl. Ins.: 225 (acc. D.T.93: 67).
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Gemmula Bassett, 1881, Canad. Ent. 13: 104. Also as *gemula.*
Geniculata Dufour, by D.T.93: 70.
Gibbosus Provancher, 1881, Nat. Canad. 12: 232.
Gigas Weld. Present assignment.
Glandiformis Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 69 (acc. D.T.93: 42).
Glandis Dahlbom, 1842, Onychia och Callaspidia suppl. page 5 no. 53.
Glandium Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 67 (acc. D.T. 93: 88).
Glandulae Schenck, 1865, Jahrb. Ver. Nassau 17-18: 177, 184. For gall only by Hartig 1840: 207.
Glechomae Linnaeus, 1758, Syst. Nat. ed. 10(1): 553.
Globuli Hartig, 1841, Germar Ent. Zeit. 3: 336.
Globulus Fitch, by Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 67.
Glutinosa Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 342.
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Guadaloupensis Fullaway. Present assignment.

Hartigi Kollar in Hartig, 1843, Germar Ent. Zeit. 4: 404.
Hayneanus Ratzeburg in Brandt and Ratzeburg, 1833, Mediz. Zoöl. 2: 154 (acc. D.T.93: 111).
Heldae Fullaway. Present assignment.
Hieracei Bouché, 1834, Naturg. Ins.: 164. For gall only by Linnaeus, 1758, Syst. Nat. ed. 10, 1: 553.
Hildebrandae Kinsey. Present assignment.
Hirta Bassett, 1864, Proc. Ent. Soc. Phila. 3: 688.
Hispanica Hartig in Rosenhauer, 1856, Th. Andalus.: 373 (acc. D.T.93: 72).
Hungarica Hartig, 1843, Germar Ent. Zeit. 4: 403.
Hyalinus Hartig, by Thomson, 1877, Opusc. Ent. :786.

Ignota Christ, 1791, Naturg. Ins.: 475, pl. 55 fig. 3 (acc. D.T.93: 71). Also as *ignita.*
Ignota Bassett, 1881, Canad. Ent. 13: 106.
Ilicicola Kinsey. Present assignment.
Ilicifoliae Bassett, 1864, Proc. Ent. Soc. Phila. 3: 682.
Ilicis Fabricius, 1798, Suppl. Ent. Syst. :213.
Inanis Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 58, 242.
Inanita Linnaeus, 1767, Syst. Nat. ed. 12, 1 (2): 920.
Incepta Kinsey. Present assignment.
Incompta Kinsey. Present assignment.
Indicta Kinsey. Present assignment.
Infectoria Hartig, 1843, Germar Ent. Zeit. 4: 421 (gall only?).
Inferus Linnaeus, 1767, Syst. Nat. ed. 12, 1 (2): 918.
Inflator Hartig, by Ratzeburg, 1844, Forstins. 3: 55.
Inoculatorius Kühn, 1782, Naturforscher 17: 219 (acc. D.T.93: 71).
Insana Mayr, 1901, Verh. zoo.-bot. Ges. Wien 51: 65.
Insignis Smith, 1857, Proc. Linn. Soc. Zoöl. 2: 117 (acc. D.T.93: 71).

Insolens Weld. Present assignment.
Interruptor Hartig, by Amerling, 1861, Lotos 11: 127 (acc. D.T.93: 40).
Irregularis Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1:54, 65.

Kelloggi Fullaway, 1911, Ann.. Ent. Soc. Amer. 4: 345, 370.
Kiefferi Cabrera, 1897, Bull. Soc. Ent. France 1897: 25.
Kollari Hartig, 1843, Germar Ent. Zeit. 4: 403.

Lana Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 814.
Lanaeglobuli Ashmead. Present assignment.
Lanigera Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XIII.
Lanuginosus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 66 (acc. D.T.93: 42).
Latreillei Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 no. 50.
Leachii Kinsey. Present assignment.
Lenticularis Olivier, by Beyerinck, 1883, Verh. Akad. Amsterdam 22: 80-85.
Lignicola Hartig, 1843, Germar Ent. Zeit. 4: 402.
Lignicola Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 252.
Litigans Kinsey. Present assignment.
Lobata McCracken and Egbert. Present assignment.
Longifoliae Froggatt, 1892, Proc. Linn. Soc. N.S.Wales (2) 7: 154.
Longipennis Fabricius, 1793, Ent. Syst. 2: 104 (acc. D.T. 93: 42).
Longispina Kieffer, 1901, André Hymén. Europe 7 (1): 541.
Longiventris Hartig, 1840, Germar Ent. Zeit. 2: 181, 188.
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Lusitanica Kieffer, 1901, André Hymén. Europe 7 (1): 97, 554.

Macrescens Kinsey. Present assignment.
Macrocarpae Karsch, by D.T.93: 73.
Macroptera Hartig, 1843, Germar Ent. Zeit. 4: 407.
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Maculosa Weld, 1926, Proc. U.S. Nat. Mus. 68(10): 63.
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Majalis Bassett, 1864, Proc. Ent. Soc. Phila. 3: 683.
Major Kinsey. Present assignment.
Malpighii Hartig, by Ratzeburg, 1844, Forstins. 3: 55 (acc. D.T. 93: 42).
Mamma Walsh & Riley, 1869, Amer. Ent. 1: 102.
Mammula Bassett, 1881, Canad. Ent. 13: 76.
Marchali Kieffer, 1901, André Hymén. Europe 7 (1): 525.
Mayri Kieffer, 1897, Bull. Soc. Ent. France 1897:8, 123.
Mediterranea Trotter, 1901, Bull. Soc. Ent. France 1901: 175.
Medullae Ashmead, 1885, Trans. Amer. Ent. Soc. 12: VIII.
Megaptera Panzer, 1801, Fauna Ins. Germ. 7: pl. 79 fig. 7 (acc. D.T. 93: 62).
Mellea Ashmead. Present assignment.
Minor Hartig, by Kaltenbach, 1874, Pflanzenfeinde: 21.

Minor Kieffer, 1901, André Hymén. Europe 7 (1): 570.
Minuta Zetterstedt, 1838, Ins. Lappon. 1: 410 (acc. D.T.93: 73).
Minuta Bassett, 1881, Canad. Ent. 13: 96.
Minutissima Ashmead, 1885, Trans. Amer. Ent. Soc. 12: VII.
Minutulus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 67 (acc. D.T.93: 44).
Minutus Kaltenbach, 1874, Pflanzenfeinde :672 (error for *minutulus* Giraud).
Mirabilis Kinsey, 1922, Ind. Univ. Study 53: 50.
Mista Kinsey. Present assignment.
Mitrata Kieffer, 1901, André Hymén. Europe 7 (1): 538. For gall only in Mayr, 1870, Mitteleur. Eichen-gallen: 19, pl. 3 fig. 21c.
Modesta Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 66.
Moniliatus Hartig, by Thomson, 1877, Opusc. Ent. 786.
Moreae Gräffe, 1905, Verh. zoo.-bot. Ges. Wien 55: 372.
Multiplicatus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 68 (acc. D.T. 93: 92).
Multipunctata Beutenmüller. Present assignment.

Nebulosus Osten Sacken, 1861, Stettiner Ent. Zeit. 22: 415 (acc. D.T. 93: 107).
Nervosa Curtis, 1838, Brit. Ent. 15: 688.
Nervosus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 69 (acc. D.T.93: 57).
Nigra Gmelin, Linné syst. Nat. ed. 13, 1: 2653 (acc. D.T.93: 73). Gall only?
Nigra Fitch, 1859, 5th Rpt. Ins. N.Y.: 782.
Nigra Fourcroy, by D.T.93: 73.
Nigrae Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 66.
Nigrescens Gillette, 1889, Psyche 5: 217.
Nigricens Gillette, 1889, Psyche 5: 217.
Nigricollis Fitch, by Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 353, 379.
Nitida Giraud, by Schenck, 1865, Jahrb. Ver. Nassau, 17-18: 177, 185.
Nitidula Dalman, 1823, Anal. Ent.: 96 (acc. D.T.93: 10).
Nitidula Goureau, 1845, Ann. Soc. Ent. France 1845: 100.
Noduli Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 60 (acc. D.T. 93: 102).
Nostra Kieffer, 1901, André Hymén. Europe 7 (1): 567.
Notha Osten Sacken, 1870, Trans. Amer. Ent. Soc. 2: 55.
Noxiosa Bassett, 1881, Canad. Ent. 13: 108.
Nubila Bassett, 1881, Canad. Ent. 13: 56.
Nubilipennis Harris, 1841, Ins. Mass. Inj. Veget.: 398.
Numismalis Olivier, 1790, Enc. Méth. 5: 787 (acc. D.T.93: 44).

Obscura Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 no. 54.
Obtrectans Kinsey. Present assignment.
Obtusilobae Karsch, by D.T.93: 74.
Omnivora Ashmead, 1885, Trans. Amer. Ent. Soc. 12: VI.
Oneratus Harris, 1841, Ins. Mass. Inj. Veget.: 398.

Operator Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 257.
Opima Kinsey. Present assignment.
Osten-sackenii Bassett, 1863, Proc. Ent. Soc. Phila. 2: 327.
Ostreus Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 67 (acc. D.T. 93: 93).
Ozark Kinsey. Present assignment.

Packorum Kinsey. Present assignment.
Palliceps Hartig, by Westwood, 1854, Trans. Ent. Soc. London 3 (2): 21 (acc. D.T.93: 113).
Pallida Olivier, by Fairmaire, 1846, Ann. Soc. Ent. France 1846: XXX.
Pallidicornis Curtis, 1838, Brit. Ent. :688.
Pallipes Bassett. Present assignment.
Palustris Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 63.
Panteli Tavares, 1902, Ann. Sci. Nat. Porto 7: 42.
Papillata Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 352.
Papula Bassett, 1881, Canad. Ent. 13: 107.
Patelloides Weld. Present assignment.
Pattoni Bassett, 1881, Canad. Ent. 13: 98.
Pedestris Curtis, 1838, Brit. Ent.: 688.
Pedunculata Bassett, by Ashmead in Packard, 1890, 5th Rpt. U.S. Ent. Comm.: 114.
Pedunculi Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Perlae Müller, 1764, Fauna Ins. Fridrichsdal: 68 (acc. D.T.93: 74).
Petiolata Zetterstedt, 1838, Ins. Lappon. 1: 409 (acc. D.T.93: 13).
Petiolata Thomson, 1877, Opus. Ent. 8: 788.
Petioli Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Petioli Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T. 93: 93).
Petiolicola Bassett, 1863, Proc. Ent. Soc. Phila. 2: 325.
Pezizaeformis Schlechtendal, by Kaltenbach, 1874, Pflanzenfeinde: 672.
Pezomachoides Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 250.
Phellos Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1:70.
Picta Hartig, in Rosenhauer, 1856, Th. Andalus.: 374 (acc. D.T.93: 75).
Pigra Bassett, 1881, Canad. Ent. 13: 105.
Pisum Fitch, 1859, 5th Rpt. Nox. Ins. N.Y.: 818.
Plumbea Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 64, fig. 12.
Podagrae Walsh, 1864, Proc. Ent. Soc. Phila. 3: 492.
Polita Bassett, 1881, Canad. Ent. 13: 99.
Politus Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T.93: 108).
Polycera Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 340.
Pomaceus Fourcroy, 1785, Ent. Paris 2: 381 (acc. D.T.93: 100).
Pomiformis Bassett, 1881, Canad. Ent. 13: 74.
Potentillae Retzius, 1783, Gen. & Spec. Ins.: 70 (acc. D.T.93: 119).
Prinoides Beutenmüller, 1892, Bull. Amer. Mus. Nat. Hist. 4: 257, pl. 11 fig. 6.
Prunus Walsh and Riley, 1869, Amer. Ent. 1: 104.
Psenes Linnaeus, 1758, Sys. Nat. ed. 10, 1: 554.

Pseudoplatani Mayer, 1779, Abh. Privatges Bohman 4: 184 (acc. D.T. 93: 131).
Pubescentis Mayr. Present assignment.
Pulchella Beutenmüller. Present assignment.
Punctata Bassett, 1863, Proc. Ent. Soc. Phila. 2: 324.
Pupoides Kinsey. Present assignment.
Pusilla Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 no. 38.
Pyriformis Olivier, by D.T.93: 76.

Quadrilineata Hartig, by Thompson, 1877, Opusc. Ent. 8: 784.
Quercus Fourcroy, by Rossi, 1790, Fauna Etrusca 2: 19 (acc. D.T.93: 54).
Quercus-folii Linnaeus, by Newman, 1868, The Ent. 4: 77.

Racemaria Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XXVI.
Racemosus Fourcroy, 1785, Ent. Paris 2: 383 (acc. D.T.93: 75).
Radicis Fabricius, 1798, Ent. Syst. suppl.: 213.
Ramuli Linnaeus, 1761, Fauna Suecica ed. 2: 387 (acc. D.T.93: 96).
Ramulorum Fonscolombe, by D.T.93: 76.
Reaumurii Hartig, 1840, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 58 (acc. D.T.93: 45).
Renum Giraud, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 61 (acc. D.T. 93: 63). *Cynips* for gall only by Hartig, 1840, Germar Ent. Zeit. 2: 208.
Rhocados Bouché, 1834, Naturg. Ins.: 164. Also as *rhoeadis*.
Rhyzomae Hartig, 1843, Germar Ent. Zeit. 4: 405.
Ribes Kinsey. Present assignment.
Rileyi Bassett, 1881, Amer. Nat. 15: 149.
Robustula Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 no. 42.
Rosae Linnaeus, 1758, Syst. Nat. ed. 10, 1: 553.
Rosae-spinosissimae Inchbald, 1861, Zoologist 19: 7824 (acc. D.T.93: 130).
Röseli Dahlbom, 1842, Onychia och Callaspidia, suppl. page 4 no. 48.
Rosenhaueri Hartig in Rosenhauer, 1856, Th. Andalus.: 373 (acc. D.T. 93: 65).
Rubi Schrank, 1781, Enum. Ins. Austr.: 320 (acc. D.T.93: 76).
Rubi Bouché, 1834, Naturg. Ins.: 163.
Rubrae Karsch, by D.T.93: 76.
Rubricosa Kinsey. Present assignment.
Rubripes Thomson, 1877, Opusc. Ent. 8: 787.
Rufa Thomson, 1877, Opusc. Ent. 8: 783.
Rufescens McCracken & Egbert, 1922, Stanford Univ. Publ. 3 (1): 21.
Ruficeps Zetterstedt, 1838, Ins. Lappon. 1: 410 (acc. D.T. 93: 36).
Ruficornis Rossi, 1794, Mant. Ins. 2: app. 106 (acc. D.T. 93: 6).
Ruficornis Schenck, 1865, Jahrb. Ver. Nassau 17-18: 182.
Rufipes Fabricius, 1804, Syst. Piez.: 148 (acc. D.T.93: 76).
Rufiventris Thomson, 1877, Opusc. Ent. 8: 783.
Rugosa Bassett, 1881, Canad. Ent. 13: 100.
Rugosa Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVIII.
Russa Kinsey Present assignment.
Rydbergiana Cockerell. Present assignment.

Salicis-strobili Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Saliens Kollar, 1857, Verh. Ver. Wien (acc. D.T. and K. 10: 323).
Saltans Giraud, 1859, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 66 (acc. D.T.93: 46).
Saltatorius Edwards, 1874, Pacif. Rural Press 2.14.74: 97.
Saltatrix Kellogg, 1904, Amer Ins., fig. 666, 667.
Saltitans Dodge, 1876, Field and Forest 2: 56, fig. on p. 53.
Scabiosae Giraud, by Kaltenbach, 1874, Pflanzenfeinde: 835.
Scelesta Kinsey. Present assignment.
Schlechtendali Kieffer. Present assignment.
Schulthessae Kinsey. Present assignment.
Scitulus Bassett, 1864, Proc. Ent. Soc. Phila. 3: 683.
Sculptus Bassett, 1863, Proc. Ent. Soc. Phila. 2: 324.
Scutellaris Rossi, 1794, Mant. Ins. 2: app. 106 (acc. D.T.93: 6).
Scutellaris Olivier, by Latreille 1810, Consid. génér. Ins.: 436.
Seminator Harris, 1841, Ins. Mass. Inj. Veget.: 399.
Semipiceus Harris, 1841, Ins. Mass. Inj. Veget.: 400.
Serotina Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 348.
Serratulae Fabricius, 1798, Suppl. Ent. Syst.: 214.
Sieboldi Hartig, 1843, Germar Ent. Zeit. 4: 406.
Similis Bassett, 1864, Proc. Ent. Soc. Phila. 3: 685.
Simulatrix Kinsey. Present assignment.
Singularis Bassett, 1863, Proc. Ent. Soc. Phila. 2: 326.
Solitarius Olivier, 1790, Enc. Méth. 5: 781 (acc. D.T.93: 100).
Solitatrix Fonscolombe, by Kaltenbach, 1874, Pflanzenfeinde: 791. Error for *solitarius* Olivier?
Sorbi Tischbein, by Kaltenbach, 1867, Verh. Ver. Rheinl. 26: 203 (acc. D.T.93: 131).
Spinosa Fonscolombe, by Blanchard in Cuvier, 1849, Règne Anim. ed. 3a Ins. 2: pl. 113 fig. 2 (acc. D.T.93: 9).
Spinosissimae Inchbald, 1861, Zoölogist 19: 7824 (acc. D.T. 93: 130).
Spongifica Osten Sacken, 1862, Proc. Ent. Soc. Phila. 1: 244, 247.
Spongiosa Karsch, by D.T.93: 76.
Stefanii Kieffer, 1897, Bull. Soc. Ent. France 1897: 8, 123.
Strians Kinsey. Present assignment.
Strobilana Osten Sacken, 1864, Proc. Ent. Soc. Phila. 3: 690.
Strobili Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Substituta Kinsey. Present assignment.
Subterranea Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 341.
Succinea Presl, 1822, Delic. Pragens. 1: 195.
Succinipes Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XI.
Sulcatus Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 123.
Superfetationis Paszlavszky, by Paszlavszky, 1884, Math. nat. Ber. Ungarn 2: 172-177 (acc. D.T.93: 101).
Suspecta Kinsey. Present assignment.
Suttonii Bassett, 1881, Canad. Ent. 13: 54.
Sycomori Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.
Synaspis Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T.93: 63).

Taschenbergi Schlechtendal, by Kaltenbach, 1874, Pflanzenfeinde: 674.
Tenuicornis Bassett, 1881, Canad. Ent. 13: 92.
Teres Weld. Present assignment.
Tergestensis Kieffer, in Gräffe, 1905, Verh. zoo.-bot. Ges. Wien 55: 370.
Terminalis Fabricius, 1798, Suppl. Ent. Syst.: 213.
Testacea Gmelin, 1790, Linné Syst. Nat. ed. 13, 1 (5): 2653 (acc. D.T. 93: 77).
Testaceipes Hartig, by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 59 (acc. D.T.93: 101).
Thaumacerus Dalman, 1823, Analecta Ent.: 96 (acc. D.T.93: 114).
Theophrastea Trotter, 1902, Atti Acc. Lincei Rend. (5) 11: 254 (acc. D.T. & K. 10: 429).
Tibialis Zetterstedt 1838, Ins. Lappon. 1: 409 (acc. D.T. 93: 1).
Tinctoriae Olivier, by Brandt & Ratzeburg, 1883, Mediz. Zool. 2: 152 (acc. D.T.93: 77).
Tojae Bosc, 1792, Journ. His. Nat. 2: 156 (acc. D.T.93: 101).
Tomentosa Trotter, 1901, Bull. Soc. Ent. France 1901: 175.
Tozae Bosc, 1792, Journ. Hist. Nat. 2: 156 (acc. D.T. & K. 10: 434).
Transversa Kieffer, 1901, André Hymén. Europe 7 (1): 529.
Tricolor Hartig, by Kaltenbach, 1874, Pflanzenfeinde: 791.
Trilineatus Hartig by Kaltenbach, 1867, Verh. Ver. Rheinl. 24: 63 (acc. D.T.93: 102).
Trinacriae Stefani, 1906, Marcellia 5: 127.
Tritior Kinsey. Present assignment.
Truncicola Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 345.
Tuber Bassett, 1864, Proc. Ent. Soc. Phila. 3: 685.
Tuberculosa Osten Sacken, 1861, Stettiner Ent. Zeit. 22: 415.
Tubicola Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 53, 60.
Tumifica Osten Sacken, 1865, Proc. Ent. Soc. Phila. 4: 341, 346, 349, 356.
Turionum Hartig, 1841, Germar Ent. Zeit. 2: 189.
Turnerii Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVI.

Undulata Gillette. Present assignment.
Unica Weld. Present assignment.
Urnaeformis Fonscolombe, by Giraud, 1859, Verh. zoo.-bot. Ges. Wien 9: 373.
Urticae Perris, 1840, Ann. Soc. Ent. France 1840: 404 (acc. D.T. & K. 10: 451).
Utricula Bassett, 1881, Canad. Ent. 13: 78.

Vacciniiformis Beutenmüller, 1913, Trans. Amer. Ent. Soc. 39: 247.
Vanescens Kinsey. Present assignment.
Ventricosa Bassett, 1864, Proc. Ent. Soc. Phila. 3: 681.
Verrucarum Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 62.
Verrucosa Schlechtendal, by Kaltenbach, 1874, Pflanzenfeinde: 674.
Vesicatrix Schlechtendal, 1870, Stettiner Ent. Zeit. 31: 397.
Vesicula Bassett, 1881, Canad. Ent. 13: 97.
Vicina Kinsey. Present assignment.
Villosa Gillette. Present assignment.
Viminalis Linnaeus, 1758, Syst. Nat. ed. 10, 1: 554.

Virens Ashmead, 1881, Trans. Amer. Ent. Soc. 9: X.
Viridis Müller, 1764, Fauna. Ins. Fridrichsdal: 68 (acc. D.T.93: 79).
Viscosae Fairmaire, 1882, Bull. Soc. Ent. France 1882: 34.
Vitis Lichtenstein, 1869, Ann. Soc. Ent. France 1869: 43, 44 (acc. D.T. & K. 10: 451).
Vorisi Kinsey. Present assignment.

Washingtonensis Gillette, 1894, Canad. Ent. 26: 235.
Weldi Beutenmüller, 1918, Bull. Brooklyn Ent. Soc. 13: 118.
Wheeleri Kinsey. Present assignment.

Zetterstedti Dahlbom, 1842, Onychia och Callaspidia, pl. 5 no. 55.

EXCLUDED SPECIES

FROM the list of several hundred names which have at various times been combined with the generic term *Cynips* and which we are now excluding from the genus, it seems necessary to make detailed comment on only a few. These are chosen for the most part from the more recent revisions of the genus, or parts of the genus, which have been published under the names *Dryophanta, Diplolepis, Acraspis,* or *Philonix,* in the following:

Dalla Torre, 1893, Cat. Hymen. 2: 48-55, 64.
Dalla Torre and Kieffer, 1902, Gen. Ins. Hymen. Cynip.: 52-53, 58.
Beutenmüller, 1909, Bull. Amer. Mus. Nat. Hist. 26: 246-254.
Dalla Torre and Kieffer, 1910, Das Tierreich 24: 342-371, 408-413.
Beutenmüller, 1911, Bull. Amer. Mus. Nat. Hist. 30: 343-369.
Weld, 1922, Proc. U.S. Nat. Mus. 61 (18): 7-15.
Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 14-36, 57-62.

Aggregata Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 15. *Diplolepis* in orig. publ. I have seen the holotype and 3 paratypes. The agamic insect has many characters of true *Cynips,* but the hypopygial spine is unusually long, slender, evenly tapered to a sharp point, and hairy over a wide area but without a terminal tuft of hairs. The agamic galls are clustered on twigs and not on leaves. These are not true *Cynips* characters.

Amorpha Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 17. *Diplolepis* in orig. publ. I have studied the holotype and most of the paratypes. The agamic insect has a smooth, shining, and naked mesonotum, distinct foveae at the base of the scutellum, and a slender, almost needle-like hypopygial spine which is without a terminal tuft of hairs. The gall is a small, hollow cylinder with the larval cell at bottom. None of the above are true *Cynips* characters.

Aquaticae Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVI. *Cynips* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have seen the National Museum types. The insect belongs to the *palustris* groups of insects and is ruled out of true *Cynips* on the same basis. See *palustris* in this list.

Atrimentus Kinsey, 1922, Bull. Amer. Mus. Nat. Hist. 46: 279. *Andricus* in orig. publ. *Diplolepis* of later authors. I have re-examined paratypes. The bisexual insect has a slender hypopygial spine which is not broadened and does not have a terminal tuft of hairs. The bisexual gall occurs in the leaf blade from which it is inseparable. None of these are true *Cynips* characters. The insect should not have been transferred to *Diplolepis* (= true *Cynips*).

Australiensis Kieffer, 1906, Marcellia 5: 105. *Dryophanta* in orig. publ. *Diplolepis* of later authors. From the original publication the insect appears to have the mesonotum smooth, shining, and nearly naked, an elongate radial cell, the cubitus lacking, and a strongly compressed abdomen, which are not true *Cynips* characters. The description of the hypopygial spine as "wide, hardly longer than wide, with erect and long hairs," would apply to a true *Cynips*. The insect came from New South Wales. Until material can be examined, or until we know more of the fauna of that region, the non-*Cynips* characters seem too many to warrant including the species in our present monograph.

Bedeguaris Fourcroy, 1785, Ent. Paris: 392. *Diplolepis* in orig. publ. and later authors. Obviously from a rose gall, the insect probably an inquiline.

Brunneipes Ashmead, 1904, Journ. N.Y. Ent. Soc. 12: 80. *Dryophanta* in orig. publ. *Diplolepis* of authors. I have examined the holotype at the National Museum. The hypopygial spine is slender, needle-like, not broadened in any place, without a terminal tuft of hairs, and entirely different from a true *Cynips*.

Caepula Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 19. *Diplolepis* in orig. publ. I have studied the holotype and numerous paratypes. The agamic insect is quite small, the mesonotum coriaceous and nearly naked, the hypopygial spine slender, needle-like, and without a terminal tuft of hairs, and the wings perfectly clear with fine veins and a very faint base to the cubitus. The gall is a hollow cone with the larval cell at bottom. The agamic insect emerges in April. None of these are true *Cynips* characters.

Californica Beutenmüller, 1911, Ent. News 22: 69. *Philonix* in orig. publ. *Biorhiza* and *Xanthoteras* of some authors. I have studied the holotypes and paratypes. The insects belong to the *discus* group and are ruled out of true *Cynips* on the same basis as *discus* *(q.v.)*.

Capillata Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 20. *Diplolepis* in orig. publ. I have studied the holotypes and most of the paratypes. The mesonotum is coriaceous to polished and almost naked, the hypopygial spine is slender, needle-like, and without a terminal tuft of hairs. The agamic galls are very small, pubescent, occurring in clusters. The adults do not emerge the first year. These characters rule it out of true *Cynips*.

Cinereae Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 129, 144. *Dryophanta* in orig. pub. *Dryophanta* and *Diplolepis* of later authors. I have seen the types which are males. They belong to the *palustris* group of insects and are ruled out of true *Cynips* on the same basis. See *palustris* in this list.

Clarkei Bassett, 1890, Trans. Amer. Ent. Soc. 17: 69. *Dryophanta* in orig. publ. *Dryophanta* and *Diplolepis* of later authors. I have seen the holotype and several paratypes in the Philadelphia Academy and other collections. This bisexual insect has a blunt hypopygial spine

which is not fine but which does not show any of the broadening characteristic of true *Cynips*.

Compressus Gillette, 1891, Bull. Ill. Lab. Nat. Hist. 3: 197. *Acraspis* in orig. publ. and later authors. I have seen the National Museum type. The tarsal claws are simple, the wings entirely lacking, and the hypopygial spine long, very slender, with scattered hairs but without a tuft of hairs terminally. The gall occurs on black oak. All of these characters disagree with those of true *Cynips*. Weld (1926, Proc. U.S. Nat. Mus. 68 (10) : 55) considers this insect a *Zopheroteras*.

Confusa Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVIII. *Cynips* in orig. publ. *Neuroterus, Dryophanta,* and *Diplolepis* of later authors. The National Museum types are lost. From the original description, this black oak insect appears to belong to the *palustris* group, and it would be ruled out of true *Cynips* on the same basis as *palustris (q.v.)*.

Corrugis Bassett, 1890, Trans. Amer. Ent. Soc. 17: 71. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have seen the types in the Philadelphia Academy. The thorax is largely smooth and shining but transversely wrinkled, the wing veins are very pale and almost colorless, and the hypopygial spine, altho rather stout and well developed, is not broadened and does not have the terminal tuft of hairs of a true *Cynips*.

Cressoni Beutenmüller, 1913, Trans. Amer. Ent. Soc. 39: 248. *Dryophanta* in orig. publ. Not known except from the holotype which is in the Beutenmüller collection and inaccessible at this time. Unless the description is correct in recording the radial cell as closed, I can see no warrant in this original publication either for including or excluding this apparently bisexual insect from true *Cynips*.

Discalis Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 24. *Diplolepis* in orig. publ. I have seen the holotype at the National Museum and several paratypes. The insect belongs to the *discus* group and is ruled out of true *Cynips* on the same basis as *discus (q.v.)*.

Discularis Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 25. *Diplolepis* in orig. publ. I have seen the holotype in the National Museum and several paratypes. Belongs to the *discus* group and is ruled out of true *Cynips* on the same basis as *discus (q.v.)*.

Discus Bassett, 1900, Trans. Amer. Ent. Soc. 26: 326. *Dryophanta* in orig. publ. *Dryophanta* and *Diplolepis* of later authors. I have seen the holotype and paratypes in the Philadelphia Academy. The insect is quite small, the hypopygial spine is long, very slender, without a terminal tuft of hairs, and very different from true *Cynips*. The gall is a small, thin, and flattened disc bearing no resemblance to any Cynips gall except that of *guadaloupensis*. The agamic insects emerge early in the spring, several months after most *Cynips*.

Dubiosa Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 339. *Diplolepis* in orig. publ. and later authors. I saw the Stanford types some years ago, and now have large series of collected material. This bisexual insect

has the hypopygial spine rather fine, blunt, and nowhere broadened, without a terminal tuft of hairs. The galls occur on black oaks. These are certainly not true *Cynips* characters.

Eburneus Bassett, 1890, Trans. Amer. Ent. Soc. 16: 70. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of most later authors. I have seen the holotype in the Philadelphia Academy and several paratypes. The antennae are too short and too stout, the mesonotum too smooth, shining, and naked for an agamic *Cynips*. The hypopygial spine is somewhat broadened at base, but it is more slender and elongate than in *Cynips*. Incomplete data indicate a bisexual generation which is very different from true *Cynips*.

Emoryi Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 115. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have seen the holotype in the National Museum and several paratypes. Originally described from the black oak, *Q. Emoryi*, but leaves with the types belong to the *Q. undulata* group of white oaks. The insect belongs to the *eburneus* group and is ruled out of *Cynips* on the same basis. See *eburneus* in this list.

Flavipes Fourcroy, 1785, Ent. Paris: 393. *Diplolepis* in orig. publ. and still maintained by Dalla Torre and Kieffer, 1910. The orig. descrip. obviously insufficient for identification of any cynipid.

Fuscus Fourcroy, 1785, Ent. Paris: 392. Based on *Diplolepis No. 5* Geoffroy, 1762, Hist. Ins. 1: 311. *Diplolepis* in orig. publ. and still maintained by Dalla Torre and Kieffer, 1910. Orig. descrip. insufficient, and does not mention the gall, so the name is unrecognizable.

Glabra Gillette, 1894, Canad. Ent. 26: 237. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of most later authors. I have studied the holotype in the U.S. National Museum. The insect is close to *eburneus* Bassett and is ruled out of true *Cynips* on the same basis. See *eburneus* in this list.

Guadaloupensis Fullaway, 1911, Ann. Ent. Soc. Amer. 4: 363, pl. 23 fig. 4. *Acraspis* acc. Weld 1926: 59. Not an *Acraspis* but an *Antron* as treated in the present monograph.

Hakonensis Ashmead, 1904, Journ. N.Y. Ent. Soc. 12: 81. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have seen all of the type series in the National Museum. The mesonotum is smooth and shining and the hypopygial spine is slender, pointed, nowhere broadened, and without a terminal tuft of hairs. These are not true *Cynips* characters.

Ignota Bassett, 1881, Canad. Ent. 13: 106. *Cynips* in orig. publ. *Andricus, Dryophanta,* and *Diplolepis* of later authors. I have seen the holotype in the Philadelphia Academy, and numerous paratypes there and in other collections. The insect bears little resemblance to a true *Cynips*. The mesonotum is prominently coriaceous and nearly naked, the scutellar foveae are well separated, the wing veins are rather fine and quite light in color, the hypopygial spine is slender, in no place

broadened, and without a terminal tuft of hairs. The gall is a wool-covered larval cell attached directly to the leaf. The agamic insects emerge in March or April. None of these are *Cynips* characters.

Insolens Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 59. *Acraspis* in orig. publ. Not an *Acraspis* but an *Antron* of the present monograph.

Japonica Ashmead, 1904, Journ. N.Y. Ent. Soc. 12:79. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have seen the holotype in the National Museum. The mesonotum is smooth and shining, the hypopygial spine is short, not fine but pointed, and except for its terminal tuft of hairs, the spine is not like that of true *Cynips*.

Lanata Gillette, 1891, Bull. Ill. Lab. Nat. Hist. 3: 198, pl. 9 fig. 5. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of most later authors. I have studied the National Museum types. The insect has simple tarsal claws, wing veins which are light in weight and color, and a hypopygial spine which is long, slender, somewhat curved, sharply pointed, and without a terminal tuft of hairs. The galls occur on black oaks. The adults emerge in the spring of the second year. These are very different from the characters of true *Cynips*.

Laurifoliae Ashmead, 1881, Trans. Amer. Ent. Soc. 9: XVII. *Spathegaster* in orig. publ. *Dryophanta* and *Diplolepis* of later authors. I have studied the National Museum types. They belong to the *palustris* group of insects and are ruled out of true *Cynips* on the same basis. See *palustris* in this list.

Liberaecellulae Gillette, 1889, Iowa Agric. Exp. Sta. Bull. 7: 283, fig. 27. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have studied four of the types at the National Museum. They are ruled out of true *Cynips* on the same basis as the other insects of the *palustris* group. See *palustris* in this list.

Longicornis Bassett, 1900, Trans. Amer. Ent. Soc. 26: 327. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have studied the holotype and paratypes in the Philadelphia Academy. It is never easy to recognize a bisexual *Cynips* and the available material of this bisexual insect offers only one female and two males which are not sufficient for a precise generic assignment. The hypopygial spine of the one female specimen is not slender but not distinctly broadened as in *Cynips*. The spine has hairs at the tip, but the hairs hardly seem as long or as abundant as they are in bisexual *Cynips*.

Mitsukurii Ashmead, 1904, Journ. N.Y. Ent. Soc. 12: 81. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have seen all of the type series in the National Museum. The mesonotum is smooth and shining, the hypopygial spine is rather short, fine, nowhere broadened, without a terminal tuft of hair, and thus very different from true *Cynips*.

Nawai Ashmead, 1904, Journ. N.Y. Ent. Soc. 12: 80. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have seen all the types in the U.S. National Museum. The mesonotum is smooth, naked, and

shining, the hypopygial spine is short, not fine but not broadened as in true *Cynips,* without the terminal tuft of hairs typical of *Cynips.*

Niger Fourcroy, 1785, Ent. Paris: 392. Based on *Diplolepis No. 4* Geoffroy, 1762, Hist. Ins. 1: 311. *Diplolepis* in orig. publ. and still maintained by Dalla Torre and Kieffer, 1910. Original description insufficient for recognizing any cynipid. Gall not described.

Notha Osten Sacken, 1870, Trans. Amer. Ent. Soc. 3: 55. *Cynips* in orig. publ. *Andricus, Callirhytis, Dryophanta* of later authors. I have compared the types with the types of *palustris* at the Museum of Comparative Zoölogy. The two insects belong to the same group and are ruled out of true *Cynips* on the same basis. See *palustris* in this list.

Occultata Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 28. *Diplolepis* in orig. publ. I have studied the holotype and numerous paratypes. The agamic insect is rather small, the mesonotum conspicuously coriaceous and almost naked, the scutellar foveae distinctly separated, the hypopygial spine slender, needle-like, and without a terminal tuft of hairs, and the wings perfectly clear with fine veins and a very faint base to the cubitus. The agamic gall is a seed-like cell in a bud. None of these are *Cynips* characters.

Operta Weld, 1926, Proc. U.S. Nat. Mus. 68 (10): 19. *Diplolepis* in orig. publ. I have studied the holotype and most of the paratypes. The agamic insect is rather small, the mesonotum conspicuously coriaceous and almost naked, the scutellar foveae distinctly separated, the hypopygial spine slender, needle-like, and without a terminal tuft of hairs, and the wings perfectly clear with fine veins and a very faint base to the cubitus. The agamic gall is a seed-like cell in a bud. None of these are *Cynips* characters.

Palustris Osten Sacken, 1861, Proc. Ent. Soc. Phila. 1: 63. *Cynips (Trigonaspis?)* in orig. publ. *Cynips, Andricus, Callirhytis,* and *Dryophanta* of later authors. I have insects which I compared with the holotypes some years ago. This bisexual insect is superficially similar to bisexual *Cynips,* but the hypopygial spine is short, not slender but nowhere broadened as in *Cynips,* and without a distinct terminal tuft of hairs. The galls are inseparable leaf galls or flower galls, spherical, hollow, with the larval cell rolling about loose in the otherwise empty gall. They occur on species of black oaks. There are several other species or varieties of this group that are commonly but wrongly assigned to our present genus. They are all ruled out of *Cynips* by the same characters.

Papula Bassett, 1881, Canad. Ent. 13: 107. *Cynips* in orig. publ. *Andricus, Dryophanta,* and *Diplolepis* of later authors. Weld (1922) considers this a *Callirhytis.* I have seen the holotype, in the Philadelphia Academy, and several paratypes. Differing from *Cynips* in every essential character. The wing veins are faint, the hypopygial spine is short, slender, pointed, without a terminal tuft of hairs, and the gall occurs on black oaks!

Parvula Bassett, 1900, Trans. Amer. Ent. Soc. 26: 326. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I saw the holotype at the Philadelphia Academy and concluded at that time that the insect was not a *Cynips*. The gall occurs on a black oak, which is not a *Cynips* character.

Patelloides Weld, 1926, Proc. U.S. Nat. Mus. 68(10): 60. **Acraspis** in orig. publ. Not an *Acraspis* but an *Antron* of the present monograph.

Pedicellatus Kinsey, 1922, Bull. Amer. Mus. Nat. Hist. 46: 284. *Andricus* in orig. publ. *Dryophanta* acc. McCracken and Egbert, 1922. I have re-examined the paratypes. The radial cell is long and narrow, the hypopygial spine is blunt and not slender, nowhere broadened, and without a terminal tuft of hairs. The gall of this bisexual insect is a precisely formed leaf gall. These are not *Cynips* characters.

Pedunculata Bassett, 1890, Trans. Amer. Ent. Soc. 17: 72. *Dryophanta* in orig. publ. *Dryophanta* and *Diplolepis* of later authors. I have seen the holotype, in the Philadelphia Academy, and several paratypes. This bisexual insect has a hypopygial spine which is slender, nowhere broadened, and without a terminal tuft of hairs. The gall is a precisely formed structure on the edges of the leaves of black oaks. These are not *Cynips* characters.

Perditor Bassett, 1900, Trans. Amer. Ent. Soc. 26: 313. *Andricus* in orig. publ. Incorrectly placed in *Acraspis* in Dalla Torre and Kieffer, 1910: 412, because Bassett's specimen had wings which were "not fully expanded." I have seen the holotype in the Philadelphia Academy. The wings are of full length altho crumpled. The thorax is transversely rugulose, the foveae are well separated, the second segment covers most of the abdomen, and the gall occurs on a black oak acorn. No one who has seen the insect has ever considered it an *Acraspis*.

Polita Bassett, 1881, Canad. Ent. 13: 99. *Cynips* in orig. publ. *Dryophanta* or *Diplolepis* of all authors since Mayr, 1881, Gen. gallenbew. Cynip.: 36. I have seen the holotype, in the Philadelphia Academy, and several paratypes. The antennae are too short and the mesonotum is too smooth, shining, and naked for an agamic *Cynips*. The hypopygial spine approaches that of an *Atrusca*, and the galls bear a similar resemblance. The agamic insects, on the other hand, emerge in the spring, a month or two later than true *Cynips*, and we have incomplete data on an alternate generation of the genus to which *polita* belongs. This bisexual form is very different from true *Cynips*.

Politus Bassett, 1890, Trans. Amer. Ent. Soc. 17: 85. *Acraspis* in orig. publ. and later authors. Weld (1922: 8) considered this a *Xystoteras*. I have studied the holotype in the Philadelphia Academy. The hypopygial spine is rather long, very slender, and without a terminal tuft of hairs. It is certainly not an *Acraspis*.

Porterae Cockerell, 1900, Canad. Ent. 32: 91. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have studied the holotype in the

U.S. National Museum. The insect belongs to the *eburneus* group and is ruled out of *Cynips* on the same basis. See *eburneus* in this list.

Pulchripennis Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 115. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of later authors. I have studied the holotype in the U.S. National Museum. The insect belongs to the *eburneus* group and is ruled out of *Cynips* on the same basis. See *eburneus* in this list.

Pumiliventris Bassett, 1890, Trans. Amer. Ent. Soc. 17: 69. *Dryophanta* in orig. publ. *Dryophanta, Diplolepis,* and *Trigonaspis* of later authors. I have seen the holotype male in the Philadelphia Academy and numerous paratype males. Weld (1921, Proc. U.S. Nat. Mus. 59: 205) concludes that this is a *Trigonaspis* synonymous with *Trigonaspis radicis* Ashmead. See the remarks on the genus under *texana* in this list.

Pusulatoides Bassett, 1890, Trans. Amer. Ent. Soc. 17: 74. *Andricus* in orig. publ. *Andricus, Dryophanta,* and *Callirhytis* of later authors. I have seen the holotype at the Philadelphia Academy. The insect is ruled out of true *Cynips* on the same basis as *palustris, (q.v.)* in this list.

Quercifoliae Ashmead, 1885, Trans. Amer. Ent. Soc. 12: 299. *Andricus* in orig. publ. *Andricus, Callirhytis, Dryophanta,* and *Diplolepis* of later authors. I have studied the holotype at the National Museum. The insect belongs to the *palustris* group, and is ruled out of true *Cynips* on the same basis. See *palustris* in this list.

Radicola Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 116. *Dryophanta* in orig. publ. *Dryophanta, Diplolepis,* and *Amphibolips* of later authors. Weld (1921, Proc. U.S. Nat. Mus. 59: 203) assigned the species to *Trigonaspis.* I have seen the holotype in the National Museum and agree with Weld's assignment. See notes on the genus under *texana* in this list.

Saccularius Bassett, 1890, Trans. Amer. Ent. Soc. 17: 76. *Andricus* in orig. publ. *Diplolepis* (as synonym of *cinereae*) in Weld 1926. I have seen the holotype, which is a male, in the Philadelphia Academy. The insect belongs to the *palustris* group *(q.v.)* and is probably ruled out of *Cynips* on the same basis.

Serratae Ashmead, 1904, Journ. N.Y. Ent. Soc. 12: 80. *Dryophanta* in orig. publ. *Diplolepis* of later authors. I have studied the holotype in the National Museum. The thorax is shagreened, the hypopygial spine is short, blunt, not widened, without a terminal tuft of hairs. These are not true *Cynips* characters. Weld has put the holotype under *Trichagalma* in the National Museum collection.

Sessilis Weld, 1926, Proc. U.S. Nat. Mus 68 (10): 31. *Diplolepis* in orig. publ. I have seen the holotype and several paratypes The galls might be accepted as *Cynips* of the subgenus *Antron,* but the insects have the hypopygial spine long, very slender, without a terminal tuft of hairs, and withal very different from the spine of true *Cynips.*

Similis Bassett, 1890, Trans Amer. Ent. Soc. 17: 71. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of most later authors. Name pre-occupied, and therefore changed to *simillima* by Dalla Torre. I have seen the holotype, in the Philadelphia Academy, and several paratypes. The insect is close to *eburneus* Bassett and is ruled out of true *Cynips* on the same basis. See *eburneus* in this list.

Simillima Dalla Torre, 1893, Cat. Hymen. 2: 54. New name for *similis* Bassett *(q.v.)*.

Splendens Weld, 1919, Canad. Ent. 51: 254. *Andricus* in orig. publ. *Diplolepis* in later publications of the same author. I have seen the holotype in the National Museum and numerous paratypes. The hypopygial spine is very slender and without a terminal tuft of hairs, and the wing venation is rather fine. The galls are hollow urns with the larval cell at bottom. The agamic insects delay emergence until March or April. These are not *Cynips* characters.

Sulcata Förster, 1869, Verh. zoo.-bot. Ges. Wien 19: 335. *Liodora* in orig. publ. *Dryophanta* of later authors. Kieffer (1901, André Hymén. Europe 7 (1) : 620) considered this a synonym of *Cynips folii folii* form *taschenbergi*. I consider the name unrecognizable. See the discussion under *taschenbergi* in the body of this paper.

Sulphurea Weld, 1926, Proc. U.S. Nat. Mus. 68 (10) : 33. *Diplolepis* in orig. publ. I have seen the holotype at the National Museum. The hypopygial spine is long, very slender, and without a terminal tuft of hairs. The gall is a hollow cone with the larval cell at the bottom. These are not *Cynips* characters.

Tecturnarum Kinsey, 1920, Bull. Amer. Mus. Nat. Hist. 42: 312, pl. 25 fig. 30-33. *Andricus* in orig. publ. *Diplolepis* in Weld 1926: 34. I have recently re-examined cotypes The hypopygial spine is very slender and without a terminal tuft of hairs, and the wing venation is rather fine. The galls are hollow urns with the larval cell at bottom, and they occur in dense clusters on the leaves. None of these are *Cynips* characters. The insects should not have been transferred to *Diplolepis* (= *Cynips*).

Tenuicornis Bassett, 1881, Canad. Ent. 13: 92. *Cynips* in orig. publ. *Holcaspis, Loxaulis,* and *Bassettia* of latter assignments. *Diplolepis* in Weld 1926. I have seen the types. The agamic insect has the mesonotum conspicuously coriaceous, the abdomen opaque and rough as ground glass, the hypopygial spine rather short, not fine but not broadened anywhere, without a terminal tuft of hairs. These are not true *Cynips* characters. The galls are polythalamous, wool-covered, hemispherical masses as different as leaf galls might be from true *Cynips* galls.

Texana Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 145. *Dryophanta* in orig. publ. *Dryophanta* or *Diplolepis* of most authors. I have seen the holotype in the National Museum. Weld has placed this material under *Trigonaspis* in the Museum's collection, and I agree with this assignment. A bisexual *Trigonaspis* is larger than a bisexual *Cynips,*

with the mesonotum very smooth and shining, the hypopygial spine rather slender, blunt, and without any broadened area, and the eyes of the male prominently enlarged. The galls and life histories differ from true *Cynips.*

Vaccinii Ashmead, 1887, Trans. Amer. Ent. Soc. 14: 127, 136. *Acraspis* in orig. publ. *Acraspis, Zopheroteras, Trigonaspis,* and *Philonix* of later authors. I have studied the holotype and the paratype in the U.S. National Museum. The tarsal claws are simple, the wings entirely lacking, and the hypopygial spine long, very slender, with scattered hairs but without a tuft terminally. These are not *Acraspis* characters.

Vacciniifoliae Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 130. *Callirhytis* in orig. publ. *Diplolepis* in Weld 1926: 36. I have seen the National Museum holotype and numerous paratypes. The thorax of the insect and the oak-apple type of leaf gall are similar to those of true *Cynips;* but the insect differs materially from *Cynips* in its rather fine wing venation, its radial cell which is very long, straight, and narrow, and its hypopygial spine which is very slender, sharply pointed, slightly curved, and without a terminal tuft of hairs.

Vesiculoides Ashmead, 1896, Proc. U.S. Nat. Mus. 19: 114. *Dryophanta* in orig. publ. *Dryophanta* and *Diplolepis* of later authors. I have seen the holotype at the National Museum. The bisexual insect has a blunt hypopygial spine which is not fine but which does not show any of the broadening characteristic of true *Cynips.*

NOMENCLATORIAL DATA

New subgenera:

Antron
Besbicus
Atrusca

New species and varieties:

Cynips folii atrifolii
C. longiventris forsiusi
C. divisa atridivisa
C. echinus vicina form *vicina*
C. echinus vicina form *incepta*
C. echinus dumosae
C. echinus mista
C. echinus schulthessae form *schulthessae*
C. echinus schulthessae form *atrata*
C. teres hildebrandae
C. multipunctata indicta
C. multipunctata conspicua
C. maculosa tritior
C. mirabilis leachii
C. fulvicollis rubricosa
C. fulvicollis vorisi
C. fulvicollis major
C. fulvicollis canadensis
C. dugèsi simulatrix
C. dugèsi pupoides
C. bella congesta
C. bella vanescens
C. centricola clivorum
C. centricola strians
C. arida
C. mellea compta
C. mellea anceps
C. mellea bifurca
C. mellea litigans
C. mellea concolor
C. mellea crassior
C. mellea albicolens
C. conica
C. nubila russa
C. villosa expositor
C. villosa apache
C. villosa calvescens
C. villosa consocians
C. gemmula cruenta
C. gemmula fuscata
C. gemmula suspecta
C. pezomachoides cincturata
C. pezomachoides ozark
C. pezomachoides wheeleri
C. pezomachoides derivatus
C. pezomachoides advena
C. hirta packorum
C. hirta obtrectans
C. hirta opima
C. hirta scelesta

New names

C. folii ilicicola for *Dryophanta ilicis* Kieffer
C. longiventris longiventris form *substituta* for *Spathegaster similis* Adler
C. teres clavuloides for *Dryophanta clavula* Beutenmüller
C. pezomachoides echinoides for *Acraspis echini* Ashmead
C. hirta macrescens for *Acraspis macrocarpae* Bassett

New synonomy

Cynips folii folii form *folii* Linnaeus
(= *Diplolepis quercus* Fourcroy)
Cynips fulvicollis fulvicollis form *fulvicollis* (Fitch)
(= *Philonix nigricollis* Fitch)
(= *Philonix niger* Gillette)
(= *Philonix gillettei* Bassett)

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31—45639

KEY TO DESCRIBED CYNIPS

DIAGNOSTIC CHARACTERS OF AGAMIC FORMS. Usually rather large and robust insects with the mesonotum punctate and more or less hairy, usually with complete parapsidal grooves, an undivided or finely divided foveal groove, a hypopygial spine which is large and distinctly broadened nearer the tip (except in short-winged *Acraspis*) and which terminates in a prominent tuft of long hairs; tarsal claws which are strongly or at least weakly toothed (except in *mellea*) ; wings long or much reduced, the long wings 1.17 to 1.60 times the body length, the short wings of various lengths down to 0.14 times the body length; the long wings usually with a smoky patch at the base of the cubital cell, sometimes with additional spots or smoky patches in this and other cells. Living (with a few exceptions) in monothalamous, highly separable leaf galls which are usually spherical, with the centrally placed larval cell closely embedded in dense, radiating fibers or more solid, spongy or crystalline material, the galls in some cases of more diverse form, especially in the subgenus *Antron*. Strictly confined to white oaks. Galls appearing in early summer, the adults maturing early in the fall, but delaying emergence until cold weather, from early winter to early spring of the first year (and successive years in *C. fulvicollis*).

DIAGNOSTIC CHARACTERS OF BISEXUAL FORMS. More slender insects, with the mesonotum largely smooth and naked, the hypopygial spine as in the agamic form but more slender; tarsal claws toothed; wings always long, 1.17 to 1.60 times the body length, less heavily spotted than in agamic forms; the males with one more antennal segment than in the female, with the third segment slightly curved, and with the abdomen long-petiolate. Galls always small, seed-like or bladdery, thin-walled cells in the undeveloped buds of the white oaks. Galls appearing with the opening buds in the spring, the adults maturing within a very few weeks.

1. Wings always 1.50 times the body length, cells always clear (except for a trace of a blotch at base of cubitus); hypopygial spine rather broad, rather drawn out ventrally. Entirely Old World species. Subgenus **Cynips, 4**

   Wings from 0.14 to 1.60 times the body length, wing cells clear or spotted, spines various. Entirely American species. **2**

2. Hypopygial spine rather broad, but drawn out ventrally (see figs. 175-190); wings normally 1.60 times the body length, or much reduced in length; with a heavy patch and sometimes spots in cubital cell. Pacific Coast species not known east of the Sierras except in southern Arizona. Subgenus **Antron, 7**

Hypopygial spine very large, as high as long, extending dorsally as far as or further than ventrally (see figs. 217-224); wing-body ratio 1.50; cubital and discoidal cells always spotted; Pacific Coast species not known east of the Sierras. Subgenus **Besbicus, 9**

Hypopygial spine usually more drawn-out and slender (broad in *Philonix* especially in short-winged forms), the normal wings 1.17 to 1.35 times the body length, but many forms with wings much reduced. Always east of the Sierras, from Mexico to southeastern Canada. 3

3. Wing-body ratio normally 1.17, the wings without spots except for traces of a blotch in the cubitus; second abscissa of radius rather straight, radial cell rather long, wide; the normal spine rather broad but projecting basally; many forms with wings much reduced and the spine much broadened and abruptly truncate posteriorly. Agamic galls of moderate size or small, spherical; bisexual forms in seed-like cells in buds. Subgenus **Philonix, 12**

Wing-body ratio normally 1.35; wings with spots and patches in many of the cells; second abscissa of radius well curved, radial cell usually short and broad (see figs. 266-273); the spine rather long and slender, not greatly widened (see figs. 276-286); the wings sometimes reduced. Agamic galls large, strictly spherical, smooth and naked "oak apples"; bisexual forms unknown.
Subgenus **Atrusca, 13**

Wing-body ratio normally 1.30, wings largely clear or with smoky patches in the cubital cell; radial cell moderately long and not narrow (see figs. 345-368), normal spine rather slender plough-shaped (see figs. 386-406); or wings reduced, sometimes to mere stubs, and then the spine usually slender, blunt, of uniform width (see figs. 407-429); agamic galls more or less spherical, ellipsoid, or conical, naked, spiny, or woolly, usually thick-walled and compact-crystalline internally in all species except *mellea;* bisexual forms in seed-like cells in buds. Subgenus **Acraspis, 16**

SUBGENUS CYNIPS

4. Agamic female with abdomen not more than half again as long as high, with tip of second segment approaching tip of abdomen dorsally; the central European varieties with the mesonotum largely punctate and hairy. Bisexual adults with mesonotum and mesopleura entirely smooth. Agamic galls spherical with considerable spongy tissue inside; bisexual galls seed-like, on twigs or older branches or the main trunk. 5

Agamic female with abdomen fully twice as long as high, with tip of second segment extending two-thirds or less to tip of abdomen; the Central European varieties with the mesonotum largely smooth

and naked. Bisexual adults (known for *divisa* only) with mesonotum roughened anteriorly about parapsidal grooves, the mesopleura with a limited rough spot. Agamic galls spherical, ellipsoid, or elongate club-shaped with very little spongy material inside; bisexual gall (known for *divisa* only) an irregularly restricted or subdivided cell attached to the edge of a leaf or rarely in buds or on young shoots. **6**

Agamic female with abdomen not more than half again as long as high, with tip of second segment extending three-quarters of way to tip; the mesonotum in part punctate and hairy with a large, smooth and naked area. Agamic gall spherical to ellipsoid with almost no spongy tissue inside. Bisexual forms unknown. **C. agama**

5. Agamic female of Central Europe with thorax robust and scutellum rugose, as much so anteriorly as posteriorly; northern European insects with mesonotum smooth. Bisexual females with legs bright, clear yellow. Agamic galls soft, sometimes spotted but not banded; bisexual galls with a shorter purplish or reddish pubescence when fresh. **C. folii, 5a**

5a. Agamic female largely rufous and piceous, mesonotum heavily punctate and hairy; scutellum as rugose anteriorly as posteriorly; length 2.8 to 4.0 mm. Agamic galls up to 30.0 mm. in diameter, spongy, shrivelling, becoming russet brown. Bisexual form as in next variety. Central European. var. **folii**

Agamic female largely rufous; mesonotum moderately punctate and hairy; scutellum smoother anteriorly than posteriorly; length 3.0 to 4.4 mm. Agamic gall up to 10.0 mm. in diameter, less spongy, not shrivelling, remaining light brown. Bisexual form as in above variety. Mediterranean Europe. var. **flosculi**

Similar to above. On *Q. Ilex* in Spain. var. **ilicicola**

Agamic female almost entirely black; mesonotum largely smooth and naked; scutellum as rugose anteriorly as posteriorly; length 2.1 to 2.7 mm. Agamic galls spongy, shrivelling, becoming russet brown. Bisexual form not known. var. **atrifolii**

Agamic female in Central Europe with thorax rather slender and with scutellum smoother especially anteriorly; northern European insects with mesonotum coriaceous or shagreened in places. Bisexual females with legs duller yellow with femora more or less piceous. Agamic galls prominently banded brown-purple. Bisexual galls with a longer, gray pubescence. **C. longiventris, 5b**

5b. Agamic female largely rufous and piceous, mesonotum largely hairy and punctate, anterior parallel and lateral lines prominent, length 2.5 to 3.8 mm. Bisexual form known. More Central European. var. **longiventris**

Agamic female nearly black, the mesonotum largely naked, anterior parallel and lateral lines not prominent, length 1.9 to 2.5 mm. More northern European. var. **forsiusi**

6. Agamic insect largely brownish rufous and black; tip of second abscissa of radius not enlarged. Agamic gall elongate horn- or club-shaped. Bisexual form not known. Mediterranean area; *Q. pubescens.* **C. cornifex**

Agamic insect largely bright rufous; tip of second abscissa slightly enlarged. Agamic gall superficially spherical but flattened on top and bottom, internally with two cavities. Bisexual form not known. **C. disticha**

Agamic insect rufous and piceous (Central Europe) or entirely black (northern Europe), tip of second abscissa prominently enlarged (Central Europe) or not enlarged (northern Europe). Agamic gall strictly spherical. Bisexual insect with mesonotum roughened about parapsidal grooves anteriorly. Bisexual gall an irregularly constricted cell on leaf or in bud. **C. divisa, 6a**

6a. Agamic female rufous and piceous, anterior parallel and lateral lines distinct, tip of second abscissa prominently bent or triangulate, length 2.8 to 4.0 mm. Bisexual form known. More Central European. var. **divisa**

Agamic female entirely black, anterior parallel and lateral lines hardly visible, tip of second abscissa not at all enlarged. Bisexual form not known. More northern Europe. var. **atridivisa**

SUBGENUS ANTRON

7. Wings long or short; if long, the cubital cell has a basal blotch and numerous spots; galls of various shapes. 8

Wings always long, cubital cell with basal blotch but no spots; galls more or less spherical, spiny, squash-shaped or vase-shaped; confined to Calif. **C. echinus, 7a**

7a. Agamic female rufous and black to mostly black; several bisexual forms known; galls various. **7b**

Agamic female wholly bright, brownish rufous; the bisexual form not known; galls irregularly cushion-shaped; *Q. dumosa;* so. Calif. var. **dumosae**

7b. The agamic female bright rufous and black, with the foveal groove slightly rugose; bisexual female with basal segments of antennae yellow or rufous yellow, always with continuous parapsidal grooves. **7c**

The agamic female dark rufous and black to mostly black, with the foveal groove smooth or finely rugose; bisexual female (where known) with basal segments of antennae rufous yellow (with parapsidal grooves indistinct anteriorly) or blackish (with continuous grooves). **7d**

7c. Agamic female indistinguishable from var. *echinus;* bisexual female with two basal segments of antennae yellow, the scutellum rather smooth; agamic gall squash-shaped; *Q. lobata,* central Calif. var. **douglasii**

Agamic female indistinguishable from var. *douglasii;* bisexual female with four or five basal segments of antennae rufous yellow; agamic galls spherical with many spines; *Q. Douglasii,* central Calif. var. **echinus**

7d. The agamic female largely dark rufous; bisexual female with antennae rufous yellow basally, parapsidal grooves indistinct anteriorly, scutellum roughly rugose; agamic galls deep bowl- or vase-shaped; *Q. durata, Q. dumosa;* Lake Co. and adjacent Calif. var. **schulthessae**

The agamic female very dark rufous and black; bisexual female (where known) with antennae brownish black basally, parapsidal grooves continuous, scutellum distinctly smoothed; agamic galls cushion-shaped or spherical with many spines. **7e**

7e. Foveal groove of agamic female usually smooth at bottom, patches in discoidal cell faint; bisexual female with antennae brownish black basally; galls spherical with many spines; *Q. Douglasii;* Lake Co. and adjacent Calif. var. **vicina**

Foveal groove of agamic female sparingly rugose at bottom, patches in discoidal cell distinct; bisexual form not known; galls cushion-shaped; *Q. dumosa;* San Bernardino area, Calif. var. **mista**

8. Wings full length or reduced to 0.52 or less of body length; galls small, elongate club-shaped; on all Pacific Coast white oaks except *Q. chrysolepis* and var. **C. teres, 8A**

8A. Thorax and abdomen of normal size, wings long; galls slender, the stalk twice the length of the swollen tip; *Q. lobata;* Central Valley of Calif. var. **clavuloides**

Thorax reduced, dark rufous, hypopygium and legs dark brownish rufous, wings 0.52 of body length, showing bases of veins

distal to areolet; galls short, with a short stalk; *Q. dumosa, Q. durata;* Lake Co. area of Calif. var. **hildebrandae**

Thorax reduced, abdomen enlarged, wings short; galls short, the stalk hardly as long as the swollen tip; *Q. garryana;* Sierras, no. Calif., and Ore. var. **teres**

Wings reduced to about 0.80 of body length; galls flattened disc-shaped, deep bowl-shaped, or pouch-shaped; *Q. chrysolepis;* Ore., Calif., So. Ariz. **C. guadaloupensis, 8a**

8a. Abdomen smooth and without aciculation; galls disc- or pouch-shaped. **8b**

Abdomen with scattered aciculation on segments three to six; mature galls deep bowl-shaped; so. Calif. mts. var. **patelloides**

8b. Mesopleuron with shining, naked spot dorsally; galls pouch-shaped; San Jacinto Mts. var. **insolens**

Mesopleuron entirely punctate and hairy; galls flattened disc-shaped. var. **guadaloupensis**

SUBGENUS BESBICUS

9. Dorsal projections of the hypopygial spine well developed (fig. 217-220), but not as long as in the next. Galls on the leaf vein, petiole, or stem; *Q. lobata, Q. Douglasii.* **10**

Dorsal projections of the spine unusually long (fig. 221-224); head rather distinctly narrower than the thorax; galls confined to the leaf veins; *Q. garryana, Q. dumosa, Q. durata,* and forms of these oaks. **11**

10. Insect hardly distinguishable from the next *(multipunctata),* with never more than a very few spots in the discoidal cell; the surface of the gall very irregular with distorted ridges and blunt spines, the gall internally solid; *Q. lobata;* Mendocino-Lake County area of Calif. **C. heldae**

Insect hardly distinguishable from the above *(heldae), sometimes* with numerous spots in the discoidal cell; the gall spherical, all but microscopically smooth, internally with compacted, sometimes solid masses of fibers; *Q. lobata, Q. Douglasii;* Great Valley of California. **C. multipunctata, 10a**

10a. Scutellum anteriorly finely rugose, wing veins not heavy, tip of radius of moderate size, cubital cell not heavily spotted, the spots not fusing, radial cell nearly unspotted; mature galls brown, nearly smooth and naked; Central Calif.; on the leaves, petioles, and young twigs; *Q. lobata.* var. **conspicua**

Scutellum anteriorly more nearly smooth, wing veins heavy, tip of radius large, abrupt; cubital cell more heavily spotted, often fusing, radial cell usually with spots; mature galls gray, appearing finely pubescent; outside the Great Valley of Calif.; leaves of *Q. Douglasii.* var. **indicta**

Scutellum anteriorly more nearly smooth, wing veins rather heavy, tip of radius of moderate size, spots in cubital cell rather heavy, often fusing, radial cell usually without spots; more Central Calif.; *Q. Douglasii.* var. **multipunctata**

11. Insect poorly distinguished from the next *(mirabilis)*, the fourth antennal segment of moderate length, discoidal cell with only very faint clouded patches but with several spots; galls small, hard, globular or flask-shaped; *Q. dumosa, Q. durata,* and forms; Calif. **C. maculosa, 11a**

11a. Light brownish in color, generally slender, tip of radius of moderate size, areolet of moderate size; galls nearly spherical; Sierran, *Q. dumosa.* var. **maculosa**

Rich, deep rufous in color, generally robust; tip of radius large, areolet very large, galls usually elongate, bulboid in shape; Lake County and rimming the Great Valley in Calif., on *Q. dumosa* and *Q. durata.* var. **tritior**

Fourth antennal segment quite long, discoidal cell with distinct smoky patches but usually without spots; galls large, thin-shelled, "oak-apples"; *Q. garryana* and forms; Calif. to Brit. Col. **C. mirabilis, 11b**

11b. Almost entirely rich rufous, median groove nearly absent, foveae very sparingly sculptured, areolet very large; no. Calif.; *Q. garryana.* var. **leachii**

Rich rufous and darker to black, median groove long, foveae distinctly sculptured, areolet moderately large; Ore. and northward, *Q. garryana.* var. **mirabilis**

SUBGENUS PHILONIX

12. Agamic insects long-winged, light brownish rufous; bisexual forms unknown; Southwest U.S. **C. plumbea**

Agamic insects short-winged, often with much black; bisexual forms in small cells in buds; eastern half of U.S. **C. fulvicollis, 12a**

12a. With considerable bright rufous, the legs largely rufous. **12b**

Predominantly dark rufous and piceous to black, the legs rufo-brown to black. **12d**

12b. Wings over 0.60 of body, insects large, up to 4.9 mm. **12c**

Wings under 0.40 of body, insects small, under 3.3 mm.; on *Q. alba* and *Q. stellata,* Tex.-Tenn. var. **rubricosa**

12c. Venation incomplete beyond areolet; on *Q. bicolor,* Fla. var. **lanaeglobuli**

Venation nearly complete; on *Q. lyrata* and chestnut oaks, Ozark area, Kans.-Ill. var. **gigas**

12d. Almost entirely black, mesonotum centrally naked and shining; small insects 1.7-3.0 mm.; on *Q. alba,* sub-Canadian. var. **canadensis**

Variable insects, varying from black to partly rufous, mesonotum centrally naked to hairy, length 2.2 to 3.7 mm.; on *Q. alba,* northeastern U.S., Kans.-Mass. var. **fulvicollis**

Always with some dark rufous, mesonotum centrally always hairy, length over 3.0 mm.; Ozark area, Kans.-Ind. **12e**

12e. Insect moderately large, 3.0-4.0 mm., not as robust as next; usually on *Q. alba,* rarely on chestnut oaks; Ozark area. var. **major**

Insect very large, 3.4-4.7 mm., more robust than preceding; on *Q. macrocarpa, Q. bicolor;* Ozark area. var. **vorisi**

SUBGENUS ATRUSCA

13. Each terminal segment of antenna gradually shorter than the preceding, second abscissa of radius much curved for most of its length, radial cell distinctly short and broad; galls unspotted; central Tex., Southwest, and Mexico. **14**

Six terminal segments of antenna abruptly shorter than the preceding; second abscissa of radius noticeably curved only near apex, radial cell of moderate length and width; galls unspotted or spotted; central Tex. and thru the eastern U.S.; *Q. stellata.* **C. centricola, 13a**

13a. Median groove poorly indicated or lacking. **13b**

Median groove well developed, at least posteriorly, the insect black with some rufous; galls usually spotted; Ozark area, Ill., Mo., Ark. var. **strians**

13b. Insect largely black, tip of second abscissa of radius not triangulate, galls unspotted; Appalachians, Ohio to Georgia. var. **clivorum**

Insect often with much rufous on head and thorax, tip of second abscissa of radius broadly triangulate; galls usually spotted; Coastal Plain, upper Miss. and lower Ohio valleys. var. **centricola**

Insect unavailable; galls spotted; Texas and adjacent area. var. **rubrae**

14. Wings 1.35 to 0.85 of body; cubital cell with distinct spots, radial or discoidal cells usually with spots or smoky patches; galls strictly spherical; West Tex., so. Colo., N.Mex., Ariz., and Mex. 15

    Wings 1.15 of body length, cubital cell with very few, faint spots, other cells unspotted; galls drawn out basally, bulb-shaped; central Tex.; *Q. breviloba.* **C. cava**

15. With spots in radial cell, anterior parallel lines not prominent, partly punctate; hypopygial spine quite long and slender; galls identical with *dugèsi;* Southwest. **C. bella, 15A**

    15A. Foveal groove usually in part smooth and shining, always with sculpturing, parapsidal grooves well separated at scutellum; West Tex., so. N.M., and Ariz. **15B**

    Foveal groove entirely tho finely rugose, parapsidal grooves rather convergent at scutellum; Apache Trail in Ariz. var. **vanescens**

    15B. Patches and spots in wings smaller, less often fused; so. N.Mex. and Ariz. var. **bella**

    Patches and spots in wings larger, more often fused; West Tex. var. **congesta**

    Without spots in radial cell, anterior parallel line prominent, mostly smooth, hypopygial spine of moderate length only; galls identical with *bella;* Southwest and Mexico. **C. dugèsi, 15a**

    15a. Wings longer than the body; so. N.Mex., Ariz., and Mexico. **15b**

    Wings shorter than the body; West Tex., no. N.Mex., and Colo. **15c**

    15b. Entire body largely bright rufous; central Mexico. var. **dugèsi**

    Entire body dark rufous and black; so. N.Mex. and Ariz. var. **simulatrix**

    15c. Head and thorax uniformly rich rufous, parapsidal grooves moderately convergent posteriorly, length 2.5 to 3.2 mm.; so. Colo. and no. N.Mex. var. **brevipennata**

    Head and thorax bright rufous with limited, darker marking; parapsidal grooves well separated posteriorly, length 2.0 to 2.5 mm.; West Tex. var. **pupoides**

SUBGENUS ACRASPIS

16. Agamic long-winged forms with smoky patches in cubital cell, agamic short-winged forms with blunt hypopygial spines of uniform width; known bisexual forms with smooth mesonota and mesopleura; agamic galls on leaves, faceted, spiny, or woolly, naked only in *arida.* 17

Agamic, long-winged forms with cubital cell entirely clear; agamic short-winged forms with slender, plough-shaped spines; bisexual forms not recognized; all agamic galls naked or at most pubescent. **22**

17. All agamic forms with short and distinctly narrow wings; agamic galls faceted to spiny; Utah and eastward; some bisexual forms known for *pezomachoides* and *gemmula.* **18**

Agamic forms with wings full length, half length, or sometimes short; in the latter case the wings are always broad; bisexual forms unknown; agamic galls naked, spiny, or wool-covered; Southwest, not in Colo. or eastward (except *villosa* varieties which have short but broadened wings). **20**

18. Abdomen nearly naked except for patches on second segment basally; agamic and some bisexual forms known; agamic galls faceted, naked to spiny. **19**

Abdomen of agamic forms largely hairy; bisexual forms not known; agamic galls faceted usually without spines (short-spiny in a Utah variety). **C. hirta, 18a**

18a. Galls ellipsoid. **18b**

Galls more nearly spheroidal. **18d**

18b. Insect deep rufo-piceous and black. **18c**

Insect bright brownish rufous, large, 2.2-3.5 mm. long; *Q. macrocarpa;* Okl. and Tex. var. **obtrectans**

Insect brownish-piceous and black; small, 1.5-2.5 mm. long; *Q. macrocarpa,* sub-Canadian. var. **scelesta**

18c. Lateral lines absent, mesopleuron entirely punctate and hairy; *Q. macrocarpa,* eastern half of U.S. var. **macrescens**

Lateral lines evident, mesopleuron with naked and shining spot dorsally; *Q. Gambelii;* So. Rocky Mts. var. **undulata**

18d. Galls faceted, smooth; on chestnut oaks, more eastern U.S. var. **hirta**

Galls faceted with the surfaces rough or short-tuberculate; on *Q. utahensis;* Utah. var. **packorum**

Galls faceted, smooth; *Q. macrocarpa,* Ozark area. var. **opima**

19. Abdomen of agamic form swollen cylindric; bisexual form with mesonotum distinctly shining and parapsidal grooves continuous; agamic galls spherical, monothalamous, without spines; bisexual galls egg-shaped, with sharp tips; on chestnut oaks. **C. gemmula, 19A**

19A. Head mostly bright or dark rufous, pronotum bright or dark rufous on edge; bisexual forms unknown; southern Ga.-so. Ind. and Kans. **19C**

Head mostly black; bisexual form known (for variety *gemmula*) in seed-like gall in bud or on young stems or flowers; Mass.-Mo. **19B**

19B. Head with some rufous about eyes, mesonotum hairy, insects 2.3-3.5 mm.; Mass.-Mo., south in mts. to Tenn. var. **gemmula**

Head entirely black, mesonotum nearly smooth and naked, insects 1.5-2.7 mm.; so. Mich.(?)-so. Ind. var. **suspecta**

19C. Head, thorax, and base of abdomen bright rufous, antennae brown, rufous basally; abdomen somewhat compressed; Ga.-so. Ind. and so. Ill. var. **cruenta**

Head and thorax dark rufous to rufo-piceous, antennae black, blackish basally, abdomen swollen cylindric; Ozark area, Ind.-Kans. var. **fuscata**

Abdomen of agamic form compressed; bisexual form with mesonotum smooth and naked but not shining, with parapsidal grooves distinctly discontinuous; agamic galls spheroidal to ellipsoid, with 1 to 8 larval cells, the surfaces faceted, naked to spiny; bisexual galls elongate-cylindric or more compressed; on true white oaks. **C. pezomachoides, 19a**

19a. Head of agamic form rufous without any black; bisexual form not known. **19b**

Head of agamic form with at least some distinct black marking; bisexual form known for *erinacei* only. **19d**

19b. Abdomen of agamic form in part piceous or black; *Q. alba*. **19c**

Abdomen of agamic form largely rufous; *Q. bicolor;* Fla. var. **echinoides**

19c. Agamic insects small (2.5 to 3.2 mm.), mesonotum largely naked, coriaceous or smoother, abdomen yellow rufous basally; gall small to medium, naked; Coastal Plain. var. **pezomachoides**

Agamic insects large (2.5 to 4.0 mm.), mesonotum quite hairy and roughly punctate, abdomen red rufous basally; gall naked, spheroidal, distinctly large; west of Appalachians. var. **derivatus**

19d. Face of agamic insects laterally and abdomen basally more or less bright rufous; bisexual form known for *erinacei*. **19e**

Face of agamic insects laterally and abdomen basally very dark rufous, piceous or black; bisexual forms unknown. 19g

19e. Agamic form with first four or five antennal segments brown rufous, head and thorax with a bright red rufous; *Q. Gambelii;* Colo. var. **cincturata**

Agamic form with never more than the first two antennal segments rufous or rufo-piceous; *Q. alba, Q. macrocarpa;* Iowa to Maine and Ga. **19f**

19f. Agamic form with rufous areas bright, mesopleuron and metapleuron almost entirely black, mesonotum naked, only finely roughened; agamic gall nearly spherical and only bristly; Cumberland Highlands and so. Appalachians. var. **advena**

Agamic form with rufous areas rather dark, mesopleuron with bright rufous center, mesonotum naked to (more often) quite hairy, usually more roughened; galls naked to well spiny; Iowa to Maine and Virginia. var. **erinacei**

19g. Antennae basally and abdomen basally piceous to black, mesonotum very dark rufous to piceous, insects of moderate length (2.0 to 3.5 mm.); Ozark areas of Ark. to Ill. var. **ozark**

Antennae basally dark brown, abdomen basally piceous to black, mesonotum dark rufous to entirely black, small insects (1.5 to 3.0 mm.); sub-Canadian areas in Northeast and Appalachians. var. **wheeleri**

20. Wings (if full length) with two, more or less distinct patches in apical half of cubital cell; or wings half-length or shorter; galls naked or with a spiny coating, or with a thinly tangled coating. **21**

Wings always full length, with smoky patches in cubital cell more or less fused (less so in Mexican var. *incompta*), wings always full length; galls with dense, woolly coating. **C. nubila, 20a**

20a. Abdomen sparsely hairy on sides of all segments; mesonotum coriaceous between punctation; parapsidal grooves obsolete anteriorly; gall russet or purple in color; live oaks, Ariz. **20b**

Abdomen hairy only on second segment, mesonotum smooth between punctation, parapsidal grooves continuous; gall golden yellow; live oaks in Central Mexico. var. **incompta**

20b. Insect same as var. *russa;* galls wine-purple; Ariz. so. of Tucson. var. **nubila**

Insect same as var. *nubila;* galls apricot to yellowish-russet; Ariz. no. of Tucson. var. **russa**

21. Wings always long, the tip of the second abscissa of radius only moderately enlarged, spots in cubital cell not very heavy; gall smooth and naked; Southwest. **C. arida**

    Wings long or half length or very short; if long, with tip of second abscissa of radius very large triangulate, spots in cubital cell large and heavy; gall with a coating of spines or coarse and tangled hairs; Southwest and Colo. east to Ind. **C. villosa, 21a**

    21a. Wings full length; galls with spines or hairs; West Tex. to Ariz. **21b**

    Wings half length, body brownish rufous; galls with stout, erect spines; Apache Trail area of Ariz. var. **apache**

    Wings much reduced; galls with short or long, flexuous hairs; N.Mex. and Utah to N.Y. **21c**

    21b. Body piceous to black; gall with stout, erect spines; *Q. undulata* var. and live oaks, so. N.Mex. and Ariz. var. **acraspiformis**

    Body mostly bright rufous; gall with tangled, flexuous hairs; *Q. grisea,* West Tex. var. **expositor**

    21c. Lateral surfaces of abdomen entirely covered with hairs; wings under 0.32 of body; Colo. to N.Y. **21d**

    Lateral surfaces of abdomen hairy with noticeable bald areas on segments two to four, wings 0.34 of body length; *Q. utahensis;* Utah. var. **calvescens**

    21d. Wings 0.32 of body length, body generally dark rufo-piceous; *Q. Gambelii* var.; no. N.Mex., so. Colo. var. **alaria**

    Wings 0.30 of body length, body generally rufous with some parts black; *Q. macrocarpa;* no. Mid-West. **21e**

    21e. Thorax more narrow, brighter rufous; northern Kans.-N.Y., *Q. macrocarpa.* var. **villosa**

    Thorax more robust, darker rufous; southern Kans., *Q. macrocarpa.* var. **consocians**

22. Always long-winged, parapsidal grooves very narrow, second abscissa of radius not heavy; gall conical with flaring base; Ariz. **C. conica**

    Long-winged or short-winged; if long-winged the parapsidal grooves are rather wide at least posteriorly and the second abscissa of the radius is rather heavy; galls spherical; no. N.Mex. to N.Y. and Fla. **C. mellea, 22a**

    22a. Abdomen with much rufous, thorax largely black; N.Y. to Fla. and Tex. **22b**

Both abdomen and thorax largely black; so. Appalachians to so. Rockies. 22e

Body entirely bright or brownish rufous; southeastern U.S. 22h

22b. Antennae rufous on whole basal half; median groove at least indicated; galls clustered, conical basally; eastern U.S. and Miss. Valley. 22c

Antennae rufous only on first two segments, median groove absent; galls occurring singly, flattened or rounded basally; Tex., Ark., and Gulf Coast. 22d

22c. Median groove indefinite, scutellum rugose, hardly longer than broad; Coastal Plain and Miss. Valley. var. **carolina**

Median groove distinct posteriorly, scutellum sculptured, longer than broad; Appalachians, Va. to Ga. and Ala. var. **crassior**

22d. Scutellum longer than broad, areolet moderate or smaller, cloud on first abscissa smaller, tip of radius hardly enlarged; eastern Tex. (and Ark.?) to Fla. var. **anceps**

Scutellum hardly longer than broad, areolet large, cloud on first abscissa larger, tip of radius enlarged; *Q. stellata;* central Tex. var. **compta**

22e. Tip of radius little if at all enlarged. 22f

Tip of radius sharply bent toward tip of wing; Ala., Ga., Tenn., so. Ind., on *Q. alba* only. var. **albicolens**

22f. Median ridge of scutellum distinct, legs rufous; So. Rockies. var. **rydbergiana**

Median ridge of scutellum more or less lost, legs brown to piceous; So. Appalachians and Ozark areas. 22g

22g. Mesonotum closely punctate and hairy, insects quite robust; Ohio to Ala. var. **litigans**

Mesonotum only moderately punctate and hairy, insects rather slender; Ozark areas, Ark. to Ky. and Ohio. var. **unica**

22h. Wings full length. var. **concolor**

Wings shortened. 22i

22i. Wings 0.47 of body length, with veins only basally; northeastern Fla. var. **mellea**

Wings 0.27 to 0.54 of body length, bifurcate apically with miniature but mostly complete venation in all but smallest wings. var. **bifurca**

CHECKLIST

Order Hymenoptera

Family Cynipidae

Tribe Cynipini

GENUS CYNIPS LINNAEUS

Subgenus Cynips Linnaeus

	C. folii Linnaeus	
1.	var. *folii*	Central Europe
	agamic form *folii* Linnaeus	
	(= *quercus* Fourcroy)	
	(= *scutellaris* Olivier)	
	(= *unedoniformis* D'Anthoine)	
	(= *gallae-cerasiformis* D'Anthoine)	
	bisex. form *taschenbergi* (Schlechtendal)	
2.	var. *flosculi*	Mediterranean area
	agamic form *pubescentis* (Mayr)	
	bisex. form *flosculi* (Giraud)	
	(= *giraudi* Tschek)	
3.	var. *ilicicola* Kinsey	*Q. Ilex,* Spain
	(= *ilicis* Kieffer)	
4.	var. *atrifolii* Kinsey	Northern Europe
	C. longiventris Hartig	
5.	var. *longiventris*	Central Europe
	agamic form *longiventris* Hartig	
	bisex. form *substituta* Kinsey	
	(= *similis* Adler)	
6.	var. *forsiusi* Kinsey	Northern Europe
	C. divisa Hartig	

7.	var. *divisa* agamic form *divisa* Hartig bisex. form *verrucosa* (Schlechtendal)	Central Europe
8.	var. *atridivisa* Kinsey	Northern Europe
9.	**C. agama** Hartig	Central Europe
10.	**C. disticha** Hartig	Europe
11.	**C. cornifex** (Kollar) Hartig	Mediterranean area

Subgenus ANTRON Kinsey

	C. echinus Osten Sacken	
12.	var. *douglasii* agamic form *douglasii* (Ashmead) bisex. form *lobata* (McCracken and Egbert)	*Q. lobata,* Central Calif.
13.	var. *echinus* agamic form *echinus* Osten Sacken (= *speciosus* Bassett) bisex. form *ribes* (Kinsey)	*Q. Douglasii,* Central Calif.
14.	var. *vicina* agamic form *vicina* Kinsey bisex. form *incepta* Kinsey	*Q. Douglasii,* Lake Co. area, Calif.
15.	var. *dumosae* Kinsey	*Q. dumosa, turbinella,* So. Calif.
16.	var. *mista* Kinsey	*Q. dumosa,* San Bernardinos, Calif.
17.	var. *schulthessae* agamic form *schulthessae* Kinsey bisex. form *atrata* Kinsey	*Q. durata, dumosa,* Lake Co. area, Calif.
	C. guadaloupensis (Fullaway)	
18.	var. *guadaloupensis* (Fullaway)	*Q. chrysolepis,* Central Calif. mts.
19.	var. *insolens* (Weld)	*Q. chrysolepis,* So. Calif. mts.
20.	var. *patelloides* (Weld)	*Q. chrysolepis,* So. Sierras, Calif.
	C. teres (Weld)	
21.	var. *clavuloides* Kinsey (= *clavula* Beutenmüller)	*Q. lobata,* Central Calif.
22.	var. *hildebrandae* Kinsey	*Q. dumosa, durata,* Lake Co. area, Calif.
23.	var. *teres* (Weld)	*Q. garryana,* Calif. mts., Ore.
	Bisex. form *pulchella* Beutenmüller	Calif., Ore.

Subgenus Besbicus Kinsey

	C. multipunctata (Beutenmüller)	
24.	var. *multipunctata* (Beutenmüller)	*Q. Douglasii,* Central Calif.
25.	var. *indicta* Kinsey	*Q. Douglasii,* Lake Co. area, Calif.
26.	var. *conspicua* Kinsey	*Q. lobata,* Central Calif.
27.	var. *heldae* Fullaway	*Q. lobata,* Lake Co. area, Calif.
	C. maculosa Weld	
28.	var. *maculosa* Weld	*Q. dumosa,* Sierras, Calif.
29.	var. *tritior* Kinsey	*Q. dumosa, durata,* Lake Co. area, Calif.
	C. mirabilis Kinsey	
30.	var. *leachii* Kinsey	*Q. garryana,* Calif.
31.	var. *mirabilis* Kinsey	*Q. garryana,* no. Calif.-Brit. Col.

Subgenus Philonix Fitch

32.	**C. plumbea** Weld	*Q. arizonica,* etc., so. Ariz., so. N. Mex.
	C. fulvicollis (Fitch)	
33.	var. *rubricosa* Kinsey	*Q. stellata, Q. alba,* Tex.-Tenn.
34.	var. *vorisi* Kinsey	*Q. macrocarpa, Q. bicolor,* etc., Ozark area, Ind.-Okla.
35.	var. *major* Kinsey	*Q. alba, Q. Michauxii,* etc., Ozark area, Ind.-Kans.
36.	var. *gigas* (Weld)	*Q. lyrata, Q. Mühlenbergii,* etc., Ozark area, Ill.-Ark.
37.	var. *lanaeglobuli* (Ashmead)	*Q. bicolor,* no. Fla.
38.	var. *fulvicollis* (Fitch)	*Q. alba,* etc., Mass.-Kans.
	agamic form *fulvicollis* (Fitch)	
	(= *Philonix nigricollis* Fitch)	
	(= *Philonix niger* Gillette)	
	(= *Philonix gillettei* Bassett)	
	bisex. form *pallipes* (Bassett)	
39.	var *canadensis* Kinsey	Sub-Canadian, northeastern U.S., Ky., etc.

Subgenus Atrusca Kinsey

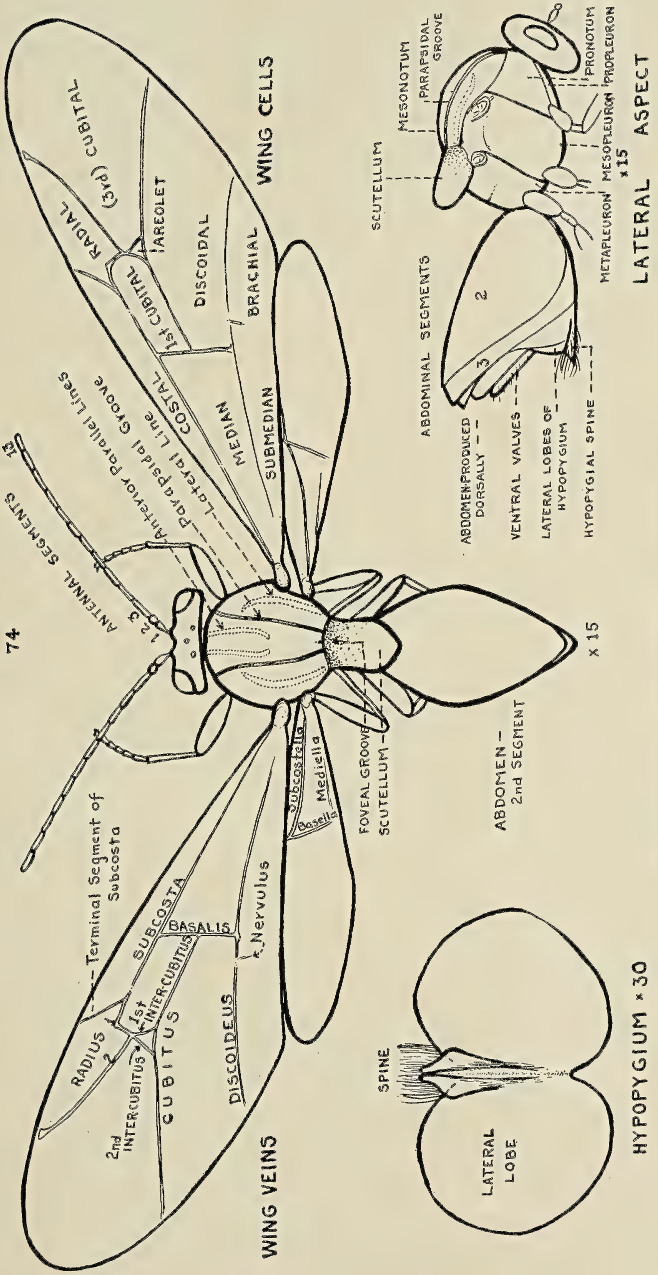
	C. dugèsi (Mayr)	
40.	var. *simulatrix* Kinsey	*Q. undulata, arizonica,* etc., so. N. Mex., so. Ariz.
41.	var. *dugèsi* (Mayr)	*Q. sp.,* central Mex.

42.	var. *brevipennata* (Gillette) (= *pellucidus* Kinsey)	*Q. Gambelii,* etc., Colo., no. N. Mex.
43.	var. *pupoides* Kinsey	*Q. grisea,* West Tex.
	C. bella Bassett	
44.	var. *bella* Bassett (= *maculipennis* Gillette)	*Q. Gambelii, arizonica,* etc., so. N. Mex., so. Ariz.
45.	var. *congesta* Kinsey	*Q. grisea,* West Tex.
46.	var. *vanescens* Kinsey	*Q. grisea,* Apache Trail area, Ariz.
47.	**C. cava** (Weld)	*Q. breviloba,* central Tex.
	C. centricola Osten Sacken	
48.	var. *centricola* Osten Sacken	*Q. stellata,* Coastal Pl. and inland ext.
49.	var. *clivorum* Kinsey	*Q. stellata,* So. Appalachians
50.	var. *rubrae* (Karsch)	*Q. stellata,* Tex.
51.	var. *strians* Kinsey	*Q. stellata,* Ozark area, Ill.-Ark.

Subgenus ACRASPIS Mayr

52.	**C. arida** Kinsey	*Q. grisea,* West Tex.
	C. mellea (Ashmead)	
53.	var. *rydbergiana* (Cockerell)	*Q. undulata,* etc., no. N. Mex.
54.	var. *unica* (Weld)	*Q. stellata,* Ozark area, Ark.-Ohio
55.	var. *compta* Kinsey	*Q. stellata,* Central Tex.
56.	var. *anceps* Kinsey	*Q. stellata, alba,* etc., Tex.-Fla.
57.	var. *bifurca* Kinsey	*Q. stellata,* etc., so. Miss.-Ga.
58.	var. *litigans* Kinsey	*Q. stellata,* etc., So. Appalachians
59.	var. *concolor* Kinsey	*Q. minima,* Fla.
60.	var. *mellea* (Ashmead)	*Q. stellata,* etc., Fla.
61.	var. *carolina* (Ashmead)	*Q. stellata, alba,* etc., Coastal Pl. and inland ext.
62.	var. *crassior* Kinsey	*Q. stellata,* Ala., Ga., Tenn., Ind.
63.	var. *albicolens* Kinsey	*Q. alba,* Ala., Ga., Tenn., Ind.
64.	**C. conica** Kinsey	*Q. grisea,* Apache Trail area, Ariz.
	C. nubila Bassett	
65.	var. *nubila* Bassett	*Q. arizonica,* etc., Ariz. so. of Tucson
66.	var. *russa* Kinsey	*Q. arizonica,* etc., Ariz. no. of Tucson
67.	var. *incompta* (Kinsey)	*Q. reticulata,* Mex.
	C. villosa (Gillette)	
68.	var. *acraspiformis* (Weld)	*Q. arizonica,* etc., so. Ariz., so N. Mex.
69.	var. *expositor* Kinsey	*Q. grisea, Q. arizonica,* West Tex.
70.	var. *apache* Kinsey	*Q. grisea, arizonica,* Apache Trail area, Ariz.
71.	var. *alaria* (Weld)	*Q. Gambelii,* etc., Colo., no. N.Mex.
72.	var. *calvescens* Kinsey	*Q. utahensis,* Utah.
73.	var. *villosa* (Gillette)	*Q. macrocarpa,* Kans.-N.Y.
74.	var. *consocians* Kinsey	*Q. macrocarpa,* Kans. (-Tex.?)

	C. gemmula Bassett	
75.	var. *cruenta* Kinsey	*Q. Michauxii,* etc., Ga., Ala., Ill., etc.
76.	var. *fuscata* Kinsey	*Q. Michauxii,* etc., Ozarks, Ky., etc.
77.	var. *suspecta* Kinsey	*Q. Michauxii,* etc., no. Mid-West (+ sub-Canadian?)
78.	var. *gemmula* agamic form *prinoides* Beutenmüller bisex. form *gemmula* Bassett	*Q. prinoides,* Northeastern U.S.
	C. pezomachoides Osten Sacken	
79.	var. *cincturata* Kinsey	*Q. Gambelii,* Colo.
80.	var. *ozark* Kinsey	*Q. alba,* Ozark area, Ind.-Ark.
81.	var. *wheeleri* Kinsey	*Q. alba,* sub-Canadian, Me.-Mich., mts. to Ga.
82.	var. *pezomachoides* Osten Sacken	*Q. alba,* Coast. Pl., N.H.-Fla.
83.	var. *derivatus* Kinsey	*Q. alba,* Ala., Ga.-so. Ill., Ind.
84.	var. *erinacei* agamic form *erinacei* (Beutenmüller) bisex. form *bicolens* (Kinsey)	*Q. alba,* no. Mid-West
85.	var. *advena* Kinsey	*Q. alba,* So. Appalachians, Cumberland Highlands
86.	var. *echinoides* Kinsey (= *echini* Ashmead)	*Q. bicolor,* Fla.
	C. hirta Bassett	
87.	var. *undulata* (Gillette)	*Q. Gambelii,* Colo., no. N.Mex.
88.	var. *packorum* Kinsey	*Q. utahensis,* Utah
89.	var. *obtrectans* Kinsey	*Q. macrocarpa,* east. Tex., Okla.
90.	var. *opima* Kinsey	*Q. macrocarpa,* so. Mid-West
91.	var. *scelesta* Kinsey	*Q. macrocarpa,* sub-Canadian
92.	var. *macrescens* Kinsey (= *macrocarpae* Bassett)	*Q. macrocarpa,* no. Mid-West
93.	var. *hirta* Bassett	*Q. Prinus,* etc., east. U.S.



STRUCTURAL DETAILS — CYNIPS FOLII

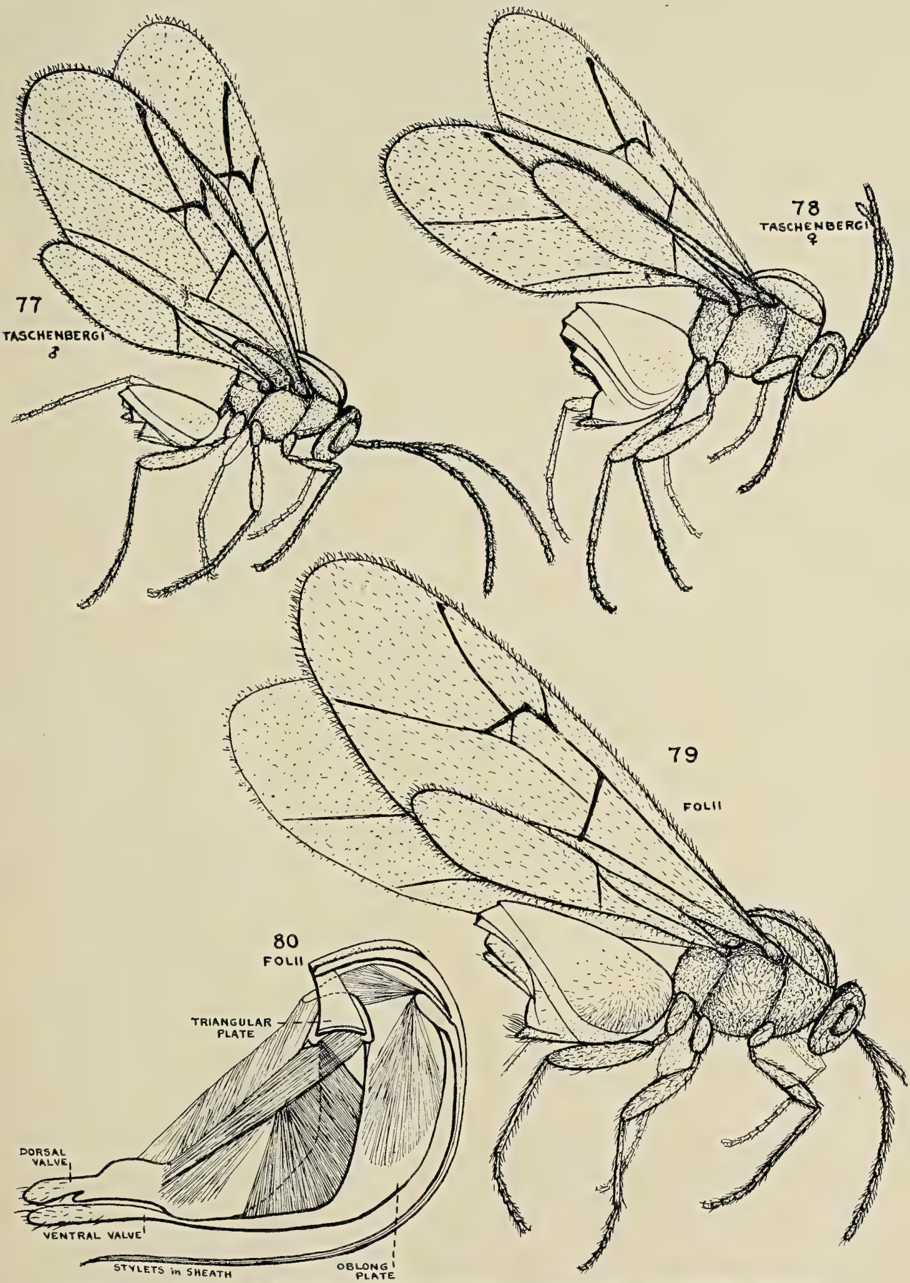
EXPLANATIONS OF PLATES

ADULTS, EUROPEAN SUBGENUS CYNIPS

Figs. 77-78. *C. folii* bisex. form *taschenbergi*, Solingen, Germany, P. Eigen, in Kinsey coll. Male = fig. 77. Female = fig. 78. X 15

Fig. 79. *C. folii* agamic form *folii*, Solingen, Germany, P. Eigen, in Kinsey coll. X 15

Fig. 80. Ovipositor, *C. folii folii*. Redrawn after Adler. X 40



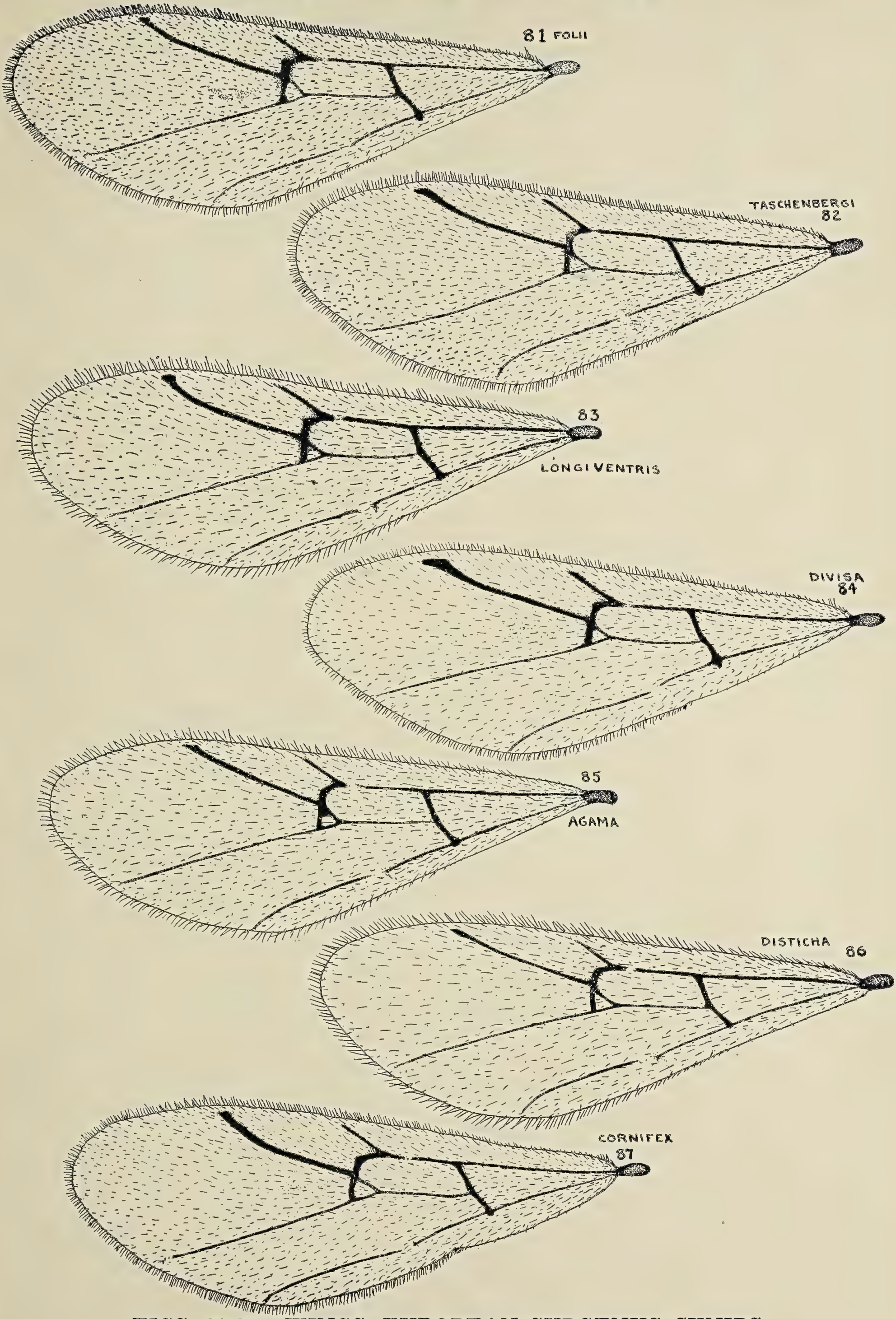
FIGS. 77-80. ALTERNATE GENERATIONS, CYNIPS FOLII

A Central European species, genotype for *Cynips*.

FRONT WINGS, EUROPEAN CYNIPS

From adults uniformly enlarged to length of 50 mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 81. *C. folii* agamic form *folii,* Bleicherode, Germany, Forsius det., in Kinsey coll.
Fig. 82. *C. folii* bisex. form *taschenbergi,* Solingen, Germany, P. Eigen, in Kinsey coll.
Fig. 83. *C. longiventris longiventris,* Solingen, Germany, P. Eigen, in Kinsey coll.
Fig. 84. *C. divisa divisa,* Bleicherode, Germany, P. Eigen, in Kinsey coll.
Fig. 85. *C. agama,* Bleicherode, Germany, P. Eigen, in Kinsey coll.
Fig. 86. *C. disticha,* Bleicherode, Germany, P. Eigen, in Kinsey coll.
Fig. 87. *C. cornifex* (Austria?), G. Mayr det., in U.S. Nat. Mus.



FIGS. 81-87. WINGS, EUROPEAN SUBGENUS CYNIPS
Note uniformity within the subgenus.

DETAILS, EUROPEAN CYNIPS

Fig. 88. Ovipositor, *C. folii* agamic form *folii.* Redrawn after Beyerinck. X 25

Figs. 89-90. Ovipositor, *C. folii* bisex. form *taschenbergi.* Fig. 89 redrawn after Beyerinck; fig. 90 redrawn after Adler. X 25

Fig. 91. Egg, *C. folii* agamic form *folii.* Redrawn after Beyerinck.

Fig. 92. Tarsal claw, *C. folii folii,* Brno, Czecho-Slovakia, Ed. Baudys, in Kinsey coll.

Fig. 93. Egg, *C. folii,* bisex. form *taschenbergi.* Redrawn from Beyerinck.

HYPOPYGIAL SPINES, EUROPEAN CYNIPS

From adults uniformly enlarged to 150 mm., so relative sizes of spines may be seen by direct comparisons of drawings

Fig. 94. *C. folii folii,* Bleicherode, Germany, Forsius det., in Kinsey coll.

Fig. 95. *C. folii pubescentis,* Budapest, Hungary, C. Sajo, in Kinsey coll.

Fig. 96. *C. folii atrifolii,* holotype, Bromme, Denmark, E. B. Hoffmeyer, in Kinsey coll.

Fig. 97. *C. longiventris longiventris,* Solingen, Germany, P. Eigen, in Kinsey coll.

Fig. 98. *C. longiventris forsiusi,* holotype, Lojo, Finland, R. Forsius, in Kinsey coll.

Fig. 99. *C. folii* bisex. form *taschenbergi,* Solingen, Germany, P. Eigen, in Kinsey coll.

Fig. 100. *C. longiventris* bisex. form *substituta,* Basnaes, Denmark, E. B. Hoffmeyer, in Kinsey coll.

Fig. 101. *C. divisa* bisex. form *verrucosa,* Thuringen, Germany, in Kinsey coll.

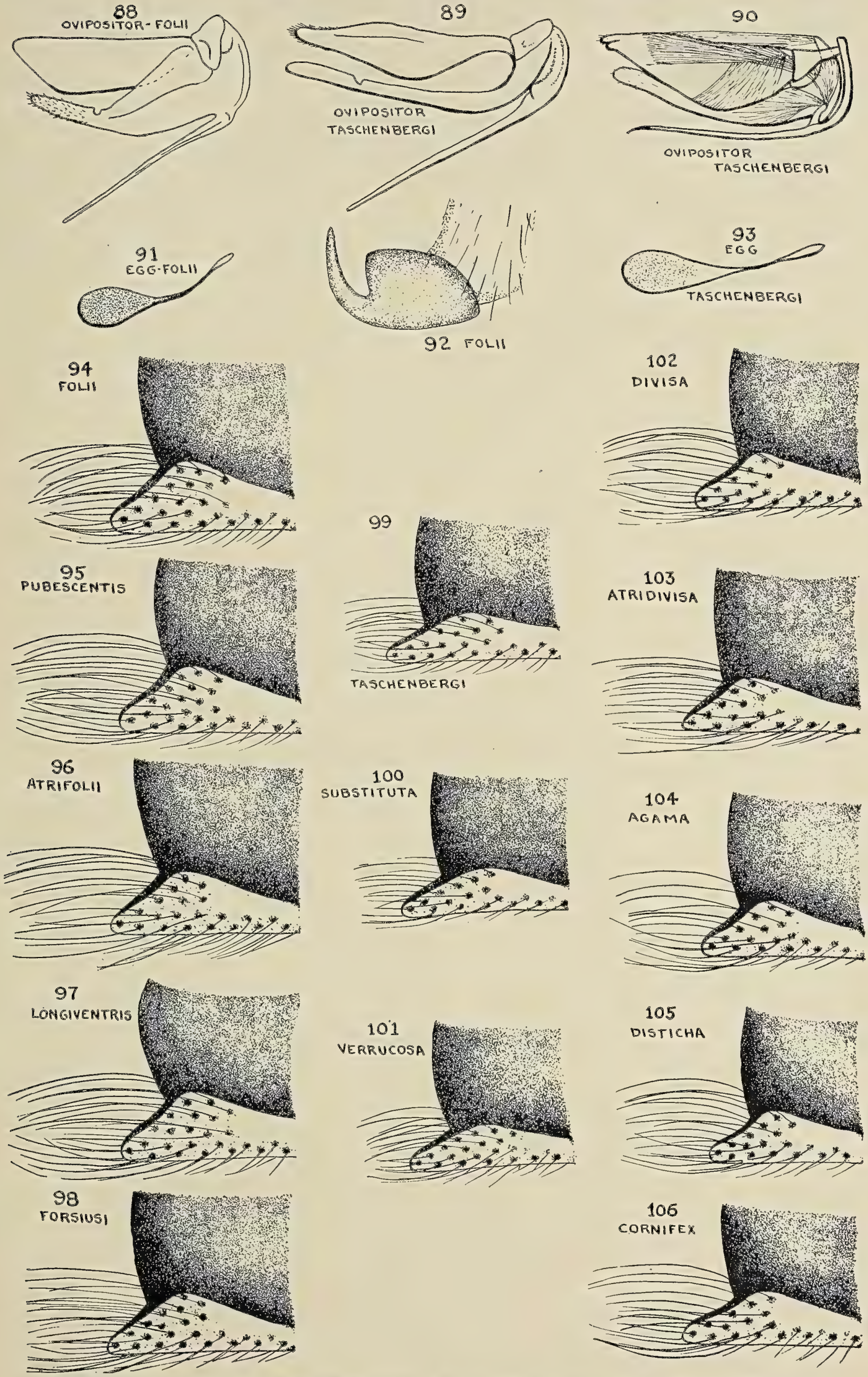
Fig. 102. *C. divisa* agamic form *divisa,* Buchy, France, *Q. pedunculata,* Noury, in Kinsey coll.

Fig. 103. *C. divisa atridivisa,* holotype, Bromme, Denmark, E. B. Hoffmeyer, in Kinsey coll.

Fig. 104. *C. agama,* Bleicherode, Germany, in Kinsey coll.

Fig. 105. *C. disticha,* Buchow, Germany, Schirmer, in Kinsey coll.

Fig. 106. *C. cornifex* (Austria?), G. Mayr det., in U.S. Nat. Mus.



FIGS. 88-106. STRUCTURAL DETAILS, SUBGENUS CYNIPS

Hypopygial spines uniform in agamic forms (figs. 94-98, 102-106); more slender in bisexual forms (figs. 99-101).

GALL FORMATION, CYNIPS FOLII

Redrawn after Beyerinck

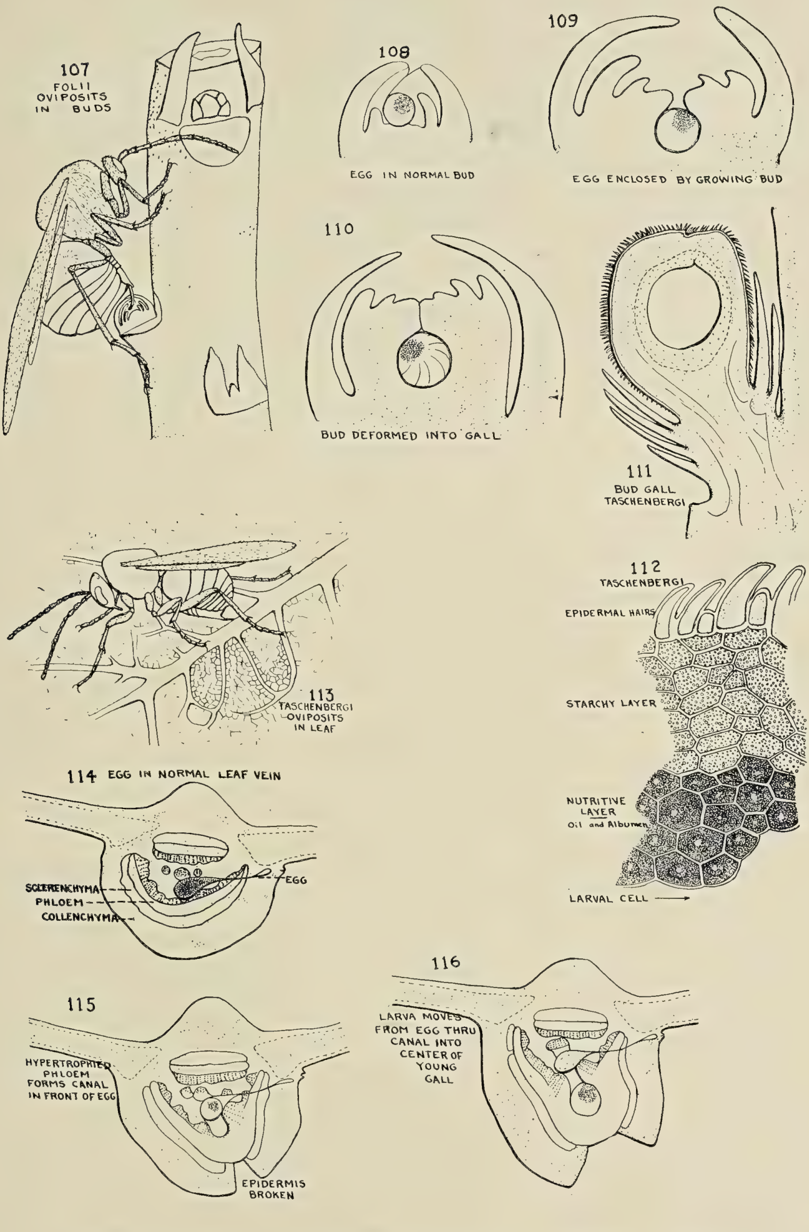
Fig. 107. Agamic adult *folii* oviposits in buds where bisex. form will subsequently develop.

Figs. 108-111. Successive stages in formation of bud galls of bisex. form *taschenbergi.*

Fig. 112. Histologic details, bud galls of bisex. form *taschenbergi.*

Fig. 113. Bisexual female *taschenbergi* oviposits in leaf vein where agamic form *folii* will subsequently develop.

Figs. 114-117. Successive stages in formation of leaf galls of agamic form *folii.*



FIGS. 107-116. GALL FORMATION, CYNIPS FOLII

Galls of bisexual form *taschenbergi* (figs. 107-112), and agamic form *folii* (figs. 113-117).

GALL DIAGRAMS, EUROPEAN CYNIPS

X 6

Fig. 117. *C. folii,* showing some histologic details. Redrawn after Beyerinck.

Fig. 118. *C. divisa divisa,* showing epidermal, parenchyma, protective, and nutritive zones.

Fig. 119. *C. cornifex,* showing epidermal, collenchyma, parenchyma, protective, and nutritive zones. Empty cavity above larval cell.

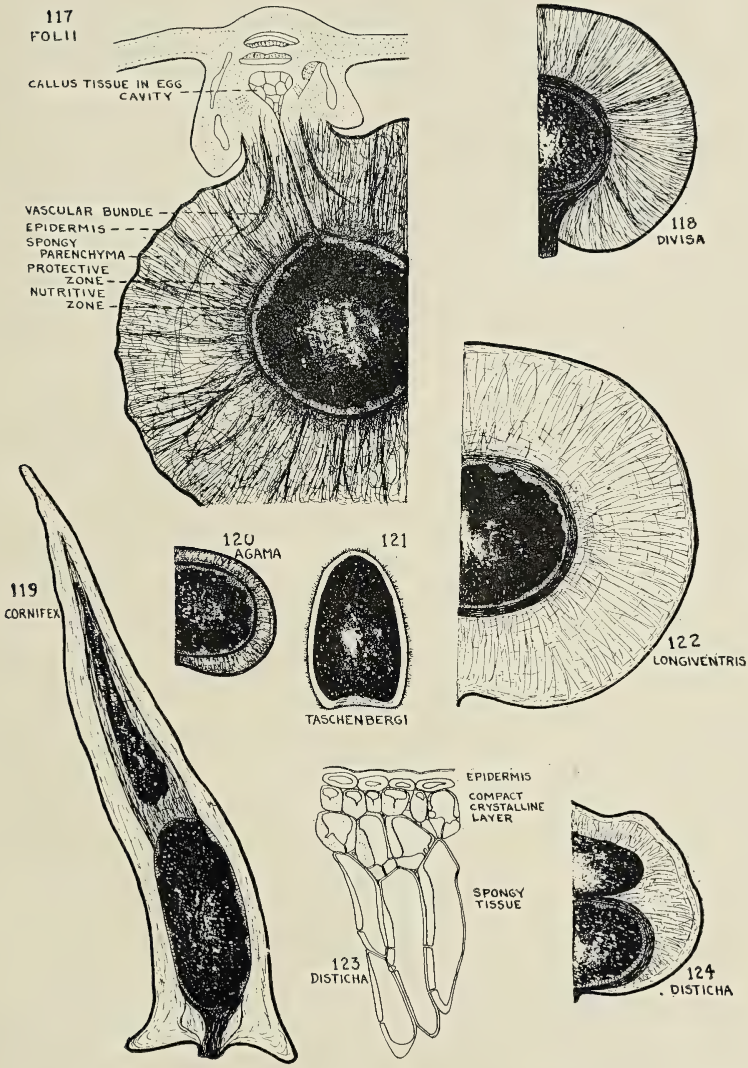
Fig. 120. *C. agama,* showing epidermal, parenchyma, protective, and nutritive zones.

Fig. 121. *C. folii taschenbergi,* showing epidermal, undifferentiated (and nutritive?) zones.

Fig. 122. *C. longiventris longiventris,* showing some collenchyma layer beneath epidermal zone.

Fig. 123. Histologic detail, *C. disticha,* showing collenchyma ("compact crystalline") layer under epidermis. Empty cavity above larval cell. Redrawn after Weidel.

Fig. 124. *C. disticha,* showing distinct collenchyma layer under epidermis.



FIGS. 117-124. GALL DIAGRAMS, SUBGENUS CYNIPS

GALLS, EUROPEAN CYNIPS

Figs. 125-126. *C. folii* agamic form *folii,* near Budapest, Hungary, C. Sajo, in Kinsey coll. X 1.5

Figs. 127-128. *C. folii* bisex. form *taschenbergi,* Berlin, Germany, in Kinsey coll. X 3

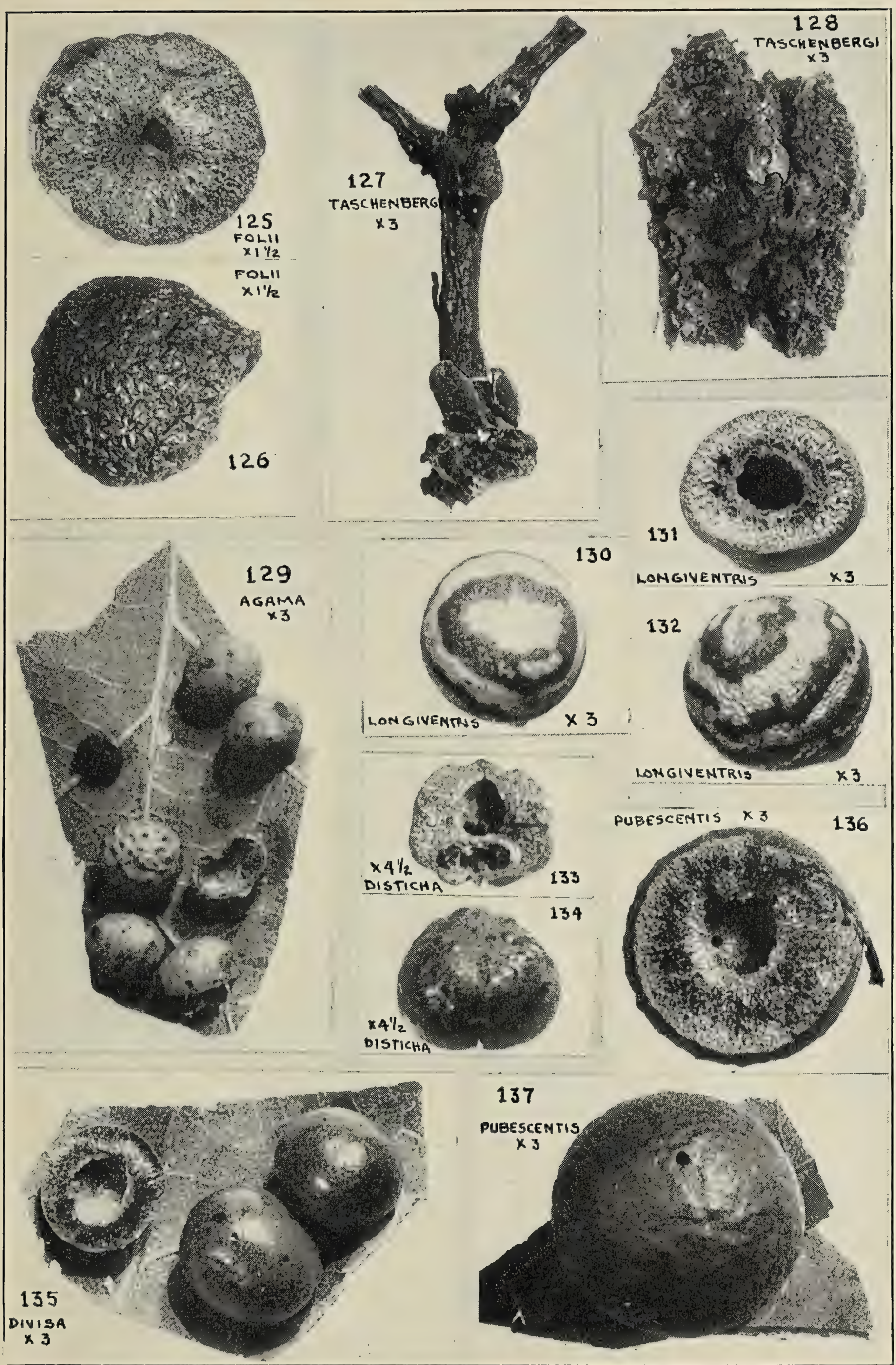
Fig. 129. *C. agama,* Dresden, Germany, in Kinsey coll. X 3

Figs. 130-132. *C. longiventris longiventris,* Stiznaes, Sjelland, Denmark, E. B. Hoffmeyer, in Kinsey coll. X 3

Figs. 133-134. *C. disticha,* Vienna, Austria, G. Mayr, in Kinsey coll. X 4.5

Fig. 135. *C. divisa divisa,* Buchy, France, *Q. pedunculata,* Noury, in Kinsey coll. X 3

Figs. 136-137. *C. folii pubescentis,* near Budapest, Hungary, C. Sajo, in Kinsey coll. X 3



FIGS. 125-137. GALLS, PART OF EUROPEAN SUBGENUS CYNIPS

GALLS, EUROPEAN CYNIPS

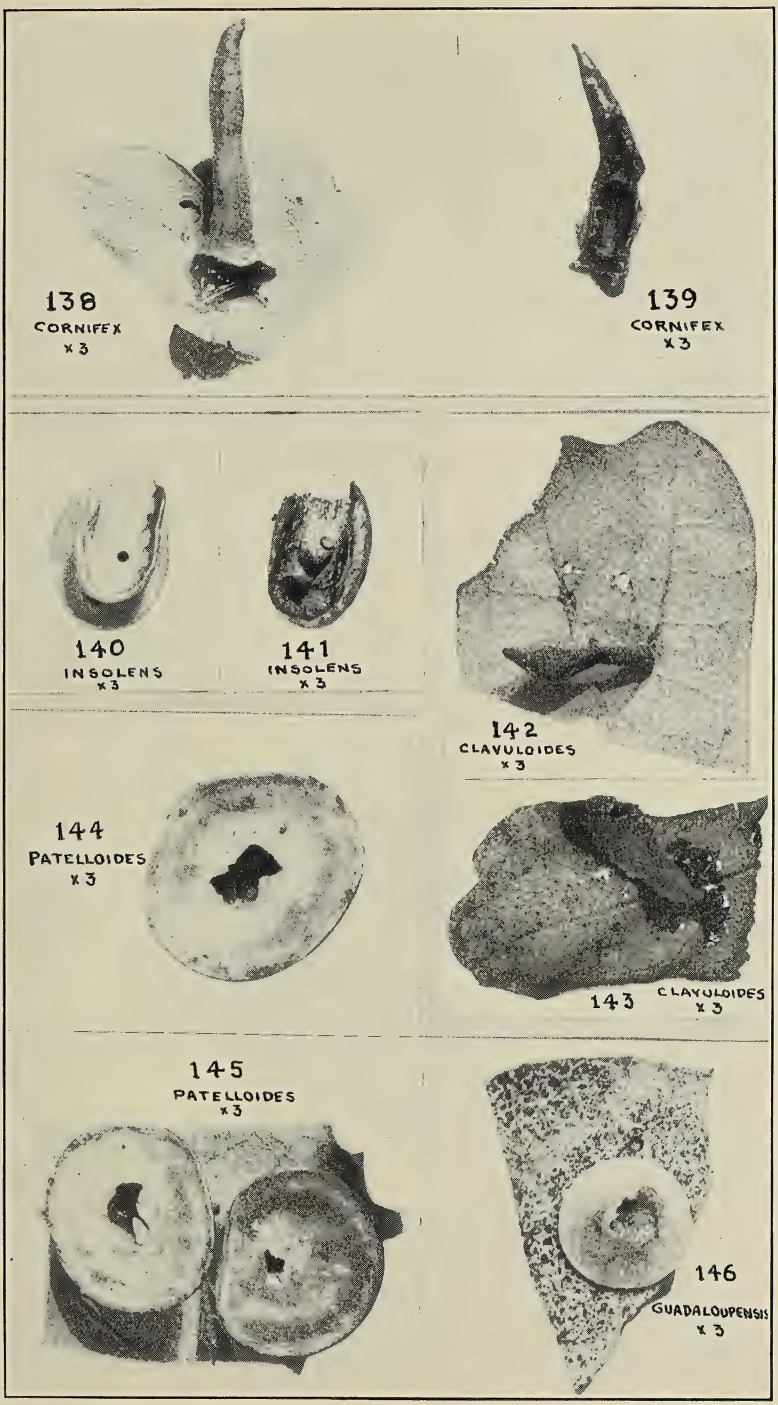
X 3

Fig. 138. *C. cornifex,* southern Austria, in Kinsey coll.
Fig. 139. *C. cornifex,* Verona, Italy, A. Trotter, in Kinsey coll.

GALLS, SUBGENUS ANTRON

X 3

Fig. 140. *C. guadaloupensis insolens,* paratype, Idyllwild, Calif., Weld, in Kinsey coll.
Fig. 141. *C. guadaloupensis insolens,* San Jacinto Mt., Calif., Kinsey coll.
Fig. 142. *C. teres clavuloides,* Diablo, Calif., F. A. Leach, in Kinsey coll.
Fig. 143. *C. teres (clavuloides?),* Dinuba, Calif., *Q. lobata,* L. H. Powell, in Kinsey coll.
Figs. 144-145. *C. guadaloupensis patelloides,* Pasadena, Calif., Kinsey coll.
Fig. 146. *C. guadaloupensis guadaloupensis* (var.?), Elk Mt. Ranger Station, Calif., Schulthess and Hildebrand, in Kinsey coll.



FIGS. 138-146. GALLS, PARTS OF SUBGENERA CYNIPS AND ANTRON

GALLS, CYNIPS (ANTRON) ECHINUS

Agamic forms, X 3

Figs. 147-148. *C. echinus dumosae,* paratypes, Upland, Calif., *Q. dumosa,* Kinsey coll.
Fig. 149. *C. echinus dumosae,* Jacumba, Calif., *Q. turbinella,* A. E. Stanley, in Kinsey coll.
Fig. 150. *C. echinus mista,* northeastern Los Angeles Co., Calif., *Q. dumosa,* W. Ebeling, in Kinsey coll.
Figs. 151-152. *C. echinus schulthessae,* paratypes, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.
Fig. 153. *C. echinus schulthessae,* Middletown, Calif., *Q. durata,* F. A. Leach, in Kinsey coll.
Figs. 154-155. *C. echinus douglasii,* Napa, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll.
Fig. 156. *C. echinus echinus,* Diablo, Calif., *Q. Douglasii,* F. A. Leach, in Kinsey coll.
Fig. 157. *C. echinus echinus,* Dinuba, Calif., *Q. Douglasii,* L. H. Powell, in Kinsey coll.
Fig. 158. Young galls, *C. echinus echinus,* Battle Creek, Calif., *Q. Douglasii,* F. A. Leach, in Kinsey coll.

Bisexual form, X 4.5

Fig. 159. *C. echinus echinus* bisex. form *ribes,* paratype, Oroville, Calif., *Q. Douglasii,* Kinsey coll.

FIGS. 147-159. GALLS, CYNIPS (ANTRON) ECHINUS

Varieties of a Pacific American species.

ADULTS, SUBGENUS ANTRON

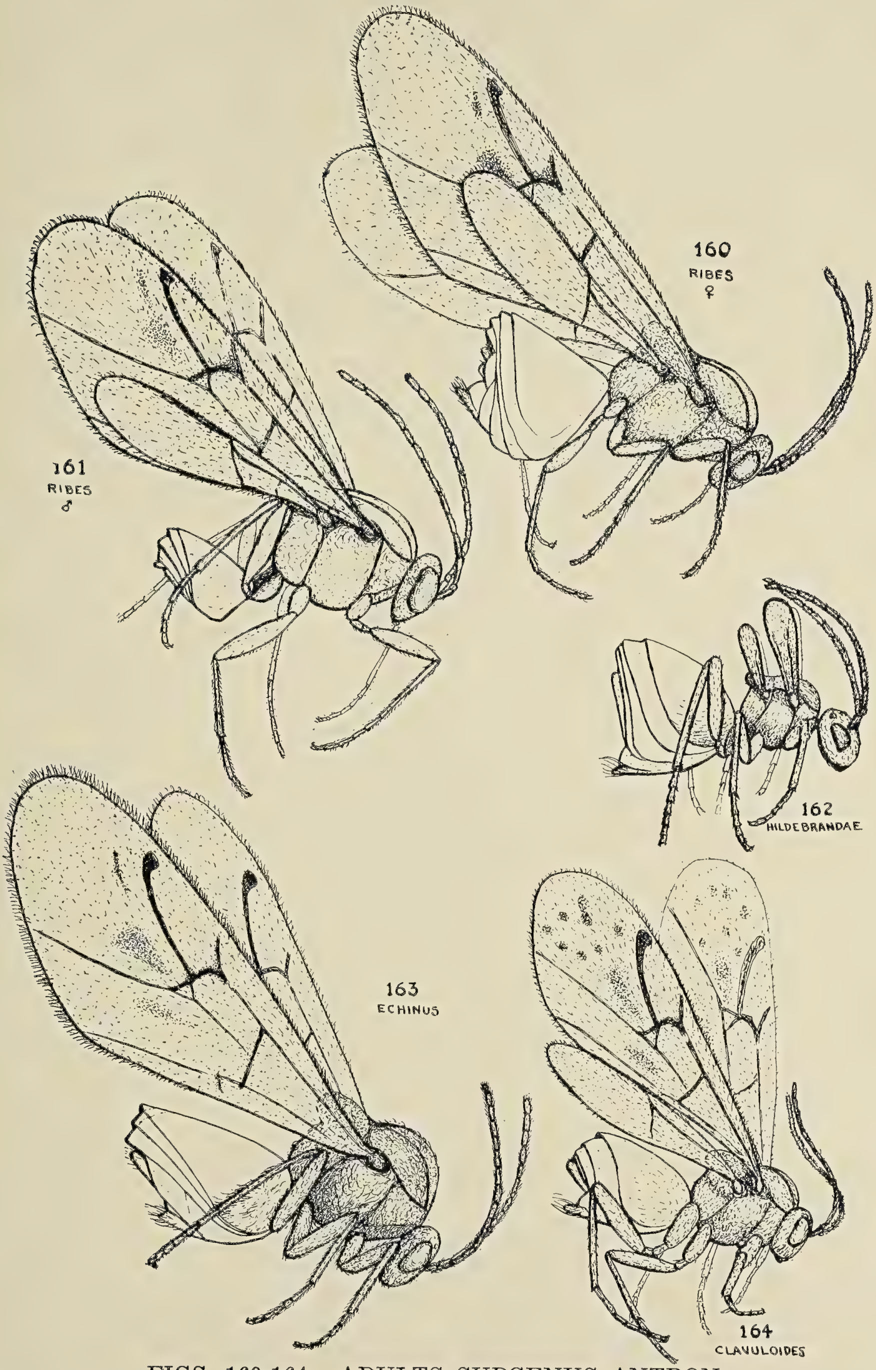
X 15

Figs. 160-161. *C. echinus echinus* bisex. form *ribes,* paratypes, Oroville, Calif., *Q. Douglasii,* Kinsey coll. Female = fig. 160. Male = fig. 161.

Fig. 162. *C. teres hildebrandae,* paratype, Seigler Springs, Calif., *Q. durata,* Hildebrand, in Kinsey coll.

Fig. 163. *C. echinus echinus* agamic form *echinus,* paratype of Bassett's *speciosus, Q. Douglasii,* Napa City, Calif., E. H. King, in Kinsey coll.

Fig. 164. *C. teres clavuloides,* from type lot, Sonoma County, Calif., A. Koebele, in Kinsey coll.



FIGS. 160-164. ADULTS SUBGENUS ANTRON

Alternate generations (figs. 160, 161, 163). A mutant relative (fig. 162) of a long-winged species (fig. 164).

FRONT WINGS, SUBGENUS ANTRON

From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 165. *C. echinus schulthessae* agamic form *schulthessae,* paratype, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.

Fig. 166. *C. echinus schulthessae* bisex. form *atrata,* paratype, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.

Fig. 167. *C. guadaloupensis insolens,* paratype, Idyllwild, Calif., Weld, in Field Mus.

Fig. 168. *C. guadaloupensis guadaloupensis,* holotype, Guadaloupe, Calif., R. W. Patterson, in Stanford Univ.

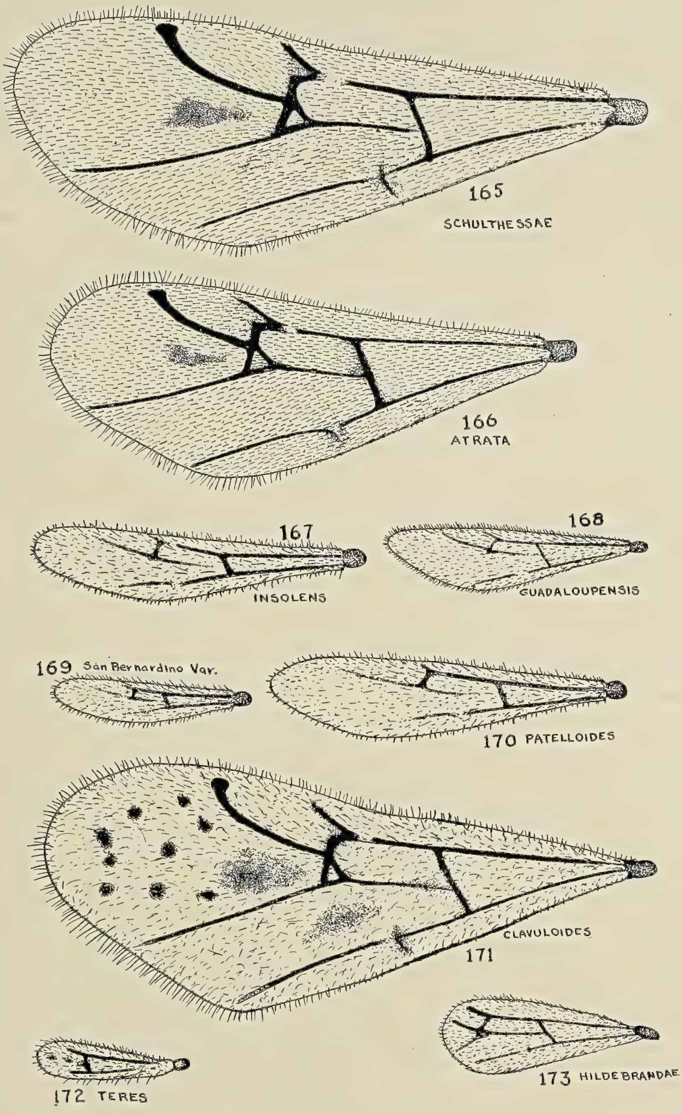
Fig. 169. *C. guadaloupensis* (var.?), San Bernardino Mts., Calif., in Weld coll.

Fig. 170. *C. guadaloupensis patelloides,* paratype (?), Idyllwild, Calif., Weld, in Field Mus.

Fig. 171. *C. teres clavuloides,* from type lot, Sonoma County, Calif., A. Koebele, in Kinsey coll.

Fig. 172. *C. teres teres,* paratype, Sequoia National Park, Calif., *Q. garryana semota,* Weld, in Kinsey coll.

Fig. 173. *C. teres hildebrandae,* holotype, Seigler Springs, Calif., *Q. durata,* Hildebrand, in Kinsey coll.



FIGS. 165-173. WING MUTANTS, SUBGENUS ANTRON
Short-winged species derived directly from long-winged stocks.

SUBGENUS ANTRON

Fig. 174. Tarsal claw, *C. echinus schulthessae,* paratype, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.

HYPOPYGIAL SPINES

From adults uniformly enlarged to 150. mm., so relative sizes of spines may be seen by direct comparisons of drawings

Fig. 175. *C. echinus douglasii,* Diablo, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll.

Fig. 176. *C. echinus echinus,* Diablo, Calif., *Q. Douglasii,* F. A. Leach, in Kinsey coll.

Fig. 177. *C. echinus vicina,* paratype, Kelseyville, Calif., *Q. Douglasii,* P. Schulthess, in Kinsey coll.

Fig. 178. *C. echinus schulthessae,* paratype, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.

Fig. 179. *C. echinus dumosae,* paratype, Upland, Calif., *Q. dumosa,* Kinsey coll.

Fig. 180. *C. echinus douglasii* bisex. form *lobata,* Three Rivers, Calif., *Q. lobata,* Kinsey coll.

Fig. 181. *C. echinus echinus* bisex. form *ribes,* paratype, Oroville, Calif., *Q. Douglasii,* Kinsey coll.

Fig. 182. *C. echinus vicina* bisex. form *incepta,* paratype, Kelseyville, Calif., *Q. Douglasii,* P. Schulthess, in Kinsey coll.

Fig. 183. *C. echinus schulthessae* bisex. form *atrata,* holotype, Kelseyville, Calif., *Q. durata,* P. Schulthess, in Kinsey coll.

Fig. 184. *C. echinus mista,* holotype, Victorville, Calif., *Q. dumosa,* V. H. Ward, in Kinsey coll.

Fig. 185. *C. guadaloupensis guadaloupensis,* holotype, Guadaloupe, Calif., R. W. Patterson, in Stanford Univ.

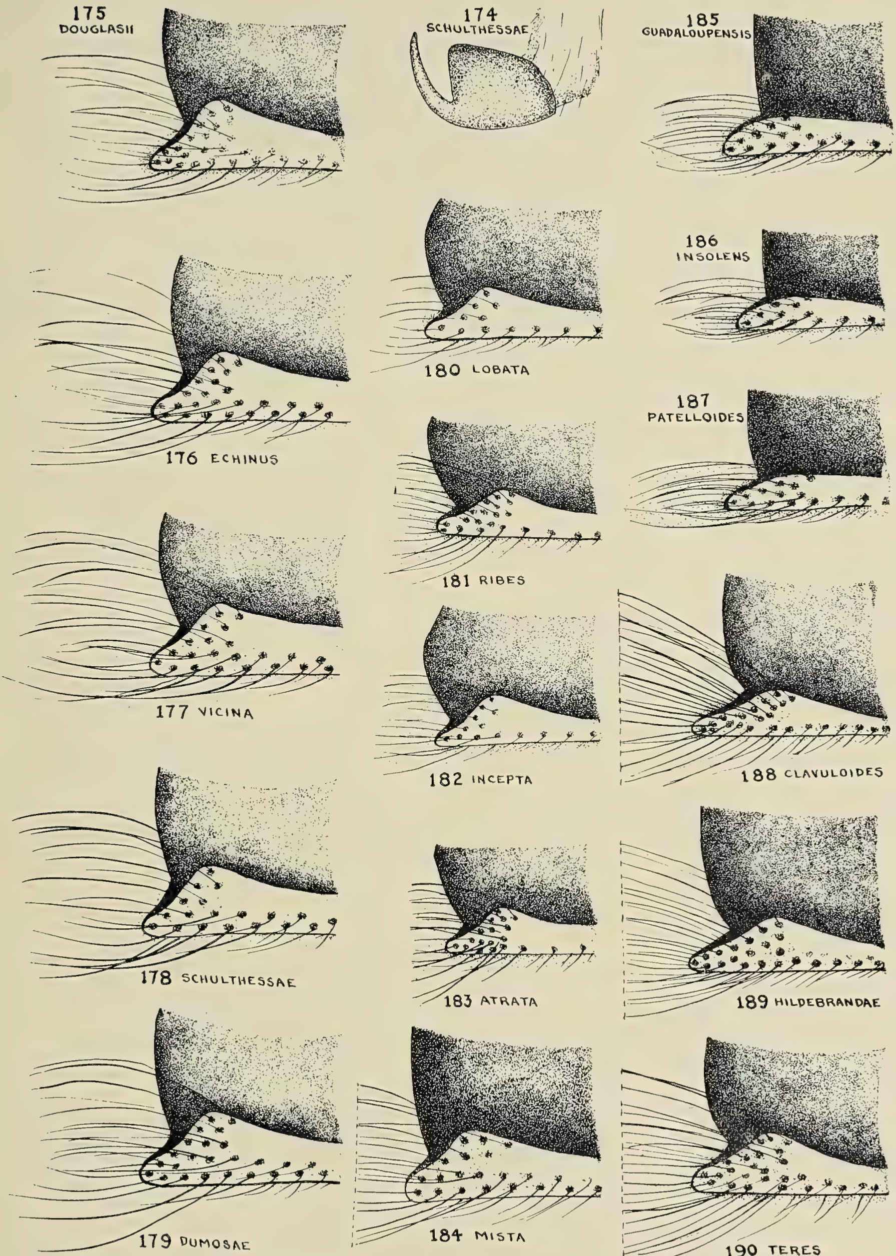
Fig. 186. *C. guadaloupensis insolens,* paratype, Idyllwild, Calif., Weld, in Field Mus.

Fig. 187. *C. guadaloupensis patelloides,* paratype (?), Idyllwild, Calif., Weld, in Field Mus.

Fig. 188. *C. teres clavuloides,* from type lot, Sonoma County, Calif., A. Koebele, in Kinsey coll.

Fig. 189. *C. teres hildebrandae,* holotype, Seigler Springs, Calif., *Q. durata,* Hildebrand, in Kinsey coll.

Fig. 190. *C. teres teres,* paratype, Sequoia National Park, Calif., *Q. garryana semota,* Weld, in Kinsey coll.



FIGS. 174-190. HYPOPYGIAL SPINES, SUBGENUS ANTRON

Spines uniform in long-winged agamic forms; more slender in bisexual forms (figs. 180-183); much modified in short-winged mutants (figs. 185-187).

GALL DIAGRAMS

X 6

ANTRON

Fig. 191. *C. echinus echinus,* showing epidermis, well developed collenchyma, scant parenchyma, protective, and nutritive zones. Empty cavity below larval cell.

Fig. 192. *C. guadaloupensis patelloides,* showing epidermis, collenchyma, compacted parenchyma, protective, and nutritive zones. Empty cavity below larval cell.

Fig. 193. *C. echinus schulthessae,* showing epidermis, large collenchyma, scant parenchyma, protective, and nutritive zones. Large empty cavity below larval cell.

Fig. 194. *C. echinus echinus* agamic form *ribes,* showing epidermis and undifferentiated parenchyma layers.

BESBICUS

Fig. 195. *C. multipunctata heldae,* showing epidermis, collenchyma, parenchyma, (protective?), and nutritive zones. No cavity except larval cell.

Fig. 196. *C. teres hildebrandae,* showing epidermis, distinct collenchyma, scant parenchyma, (protective?) and nutritive zones. Some cavity below larval cell.

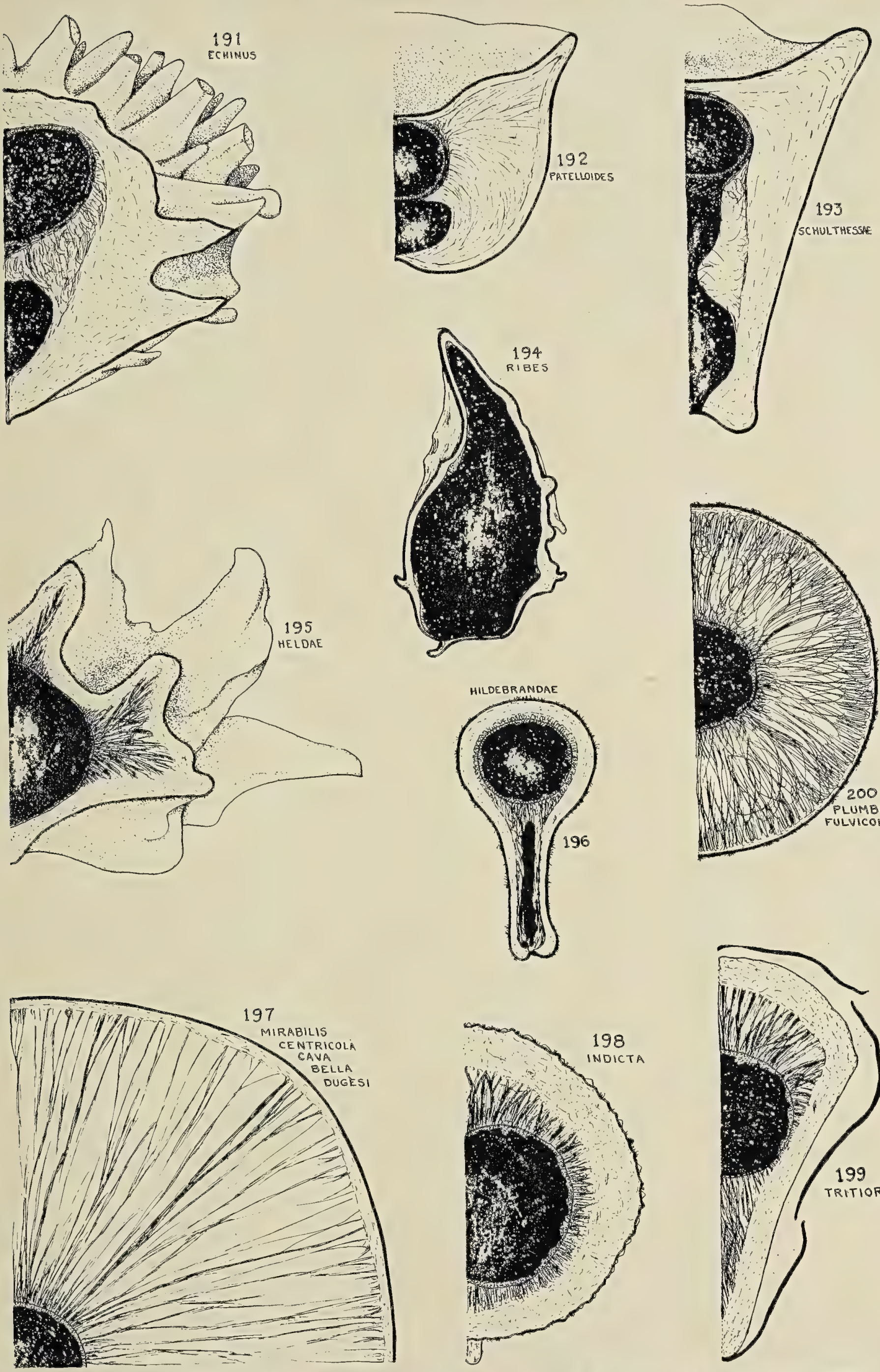
Fig. 197. Figure applies to *C. (Besbicus) mirabilis,* and to all species of *Atrusca.* Showing epidermis, some collenchyma, extensive fibrous parenchyma, (protective?) and nutritive zones.

Fig. 198. *C. multipunctata indicta,* showing epidermis, distinct collenchyma, parenchyma, (protective?), and nutritive zones.

Fig. 199. *C. maculosa tritior,* showing broken epidermis, distinct collenchyma, parenchyma, (protective?), and nutritive zones.

PHILONIX

Fig. 200. Applies to both *C. plumbea* and *C. fulvicollis.* Showing epidermis, scant collenchyma, extensive fibro-compact parenchyma, (protective?), and nutritive zones.



FIGS. 191-200. GALL DIAGRAMS, ANTRON, BESBICUS, PHILONIX, ATRUSCA

GALLS, SUBGENUS BESBICUS

Figs. 201-202. *C. multipunctata indicta,* paratypes, Kelseyville, Calif., *Q. Douglasii,* P. Schulthess, in Kinsey coll. X 3

Figs. 203-204. *C. multipunctata conspicua,* Diablo, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll. X 3

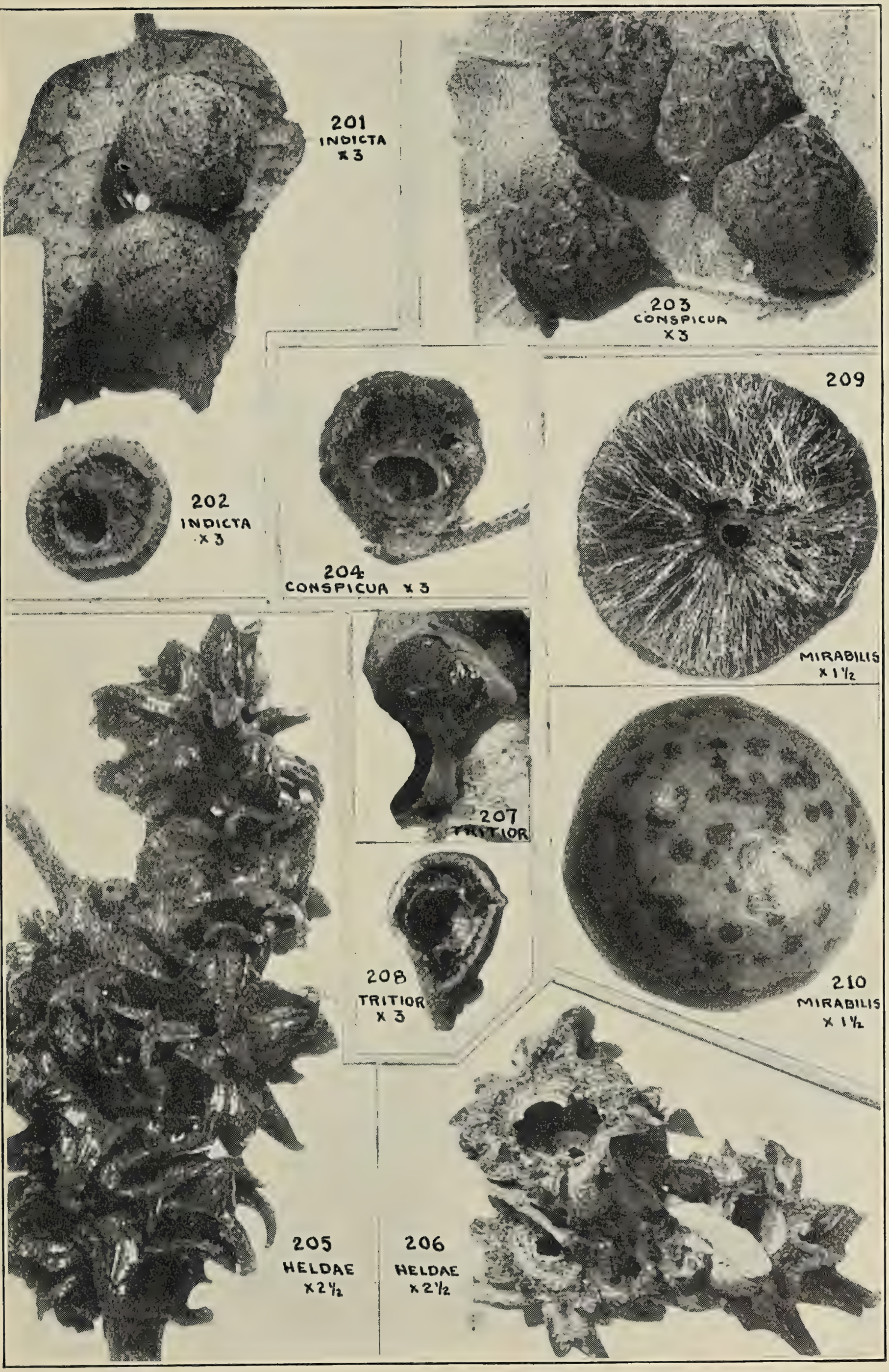
Fig. 205. *C. multipunctata heldae,* Clear Lake, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll. X 2.5

Fig. 206. *C. multipunctata heldae,* Cloverdale, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll. X 2.5

Fig. 207. *C. maculosa tritior,* Scott Valley, Calif., *Q. dumosa,* Schulthess, in Kinsey coll. X 3

Fig. 208. *C. maculosa tritior,* paratype, Kelseyville, *Q. durata,* Schulthess, in Kinsey coll. X 3

Figs. 209-210. *C. mirabilis mirabilis,* Ashland, Oregon, *Q. garryana,* Kinsey coll. X 1.5



FIGS. 201-210. GALLS, PACIFIC AMERICAN SUBGENUS BESBICUS

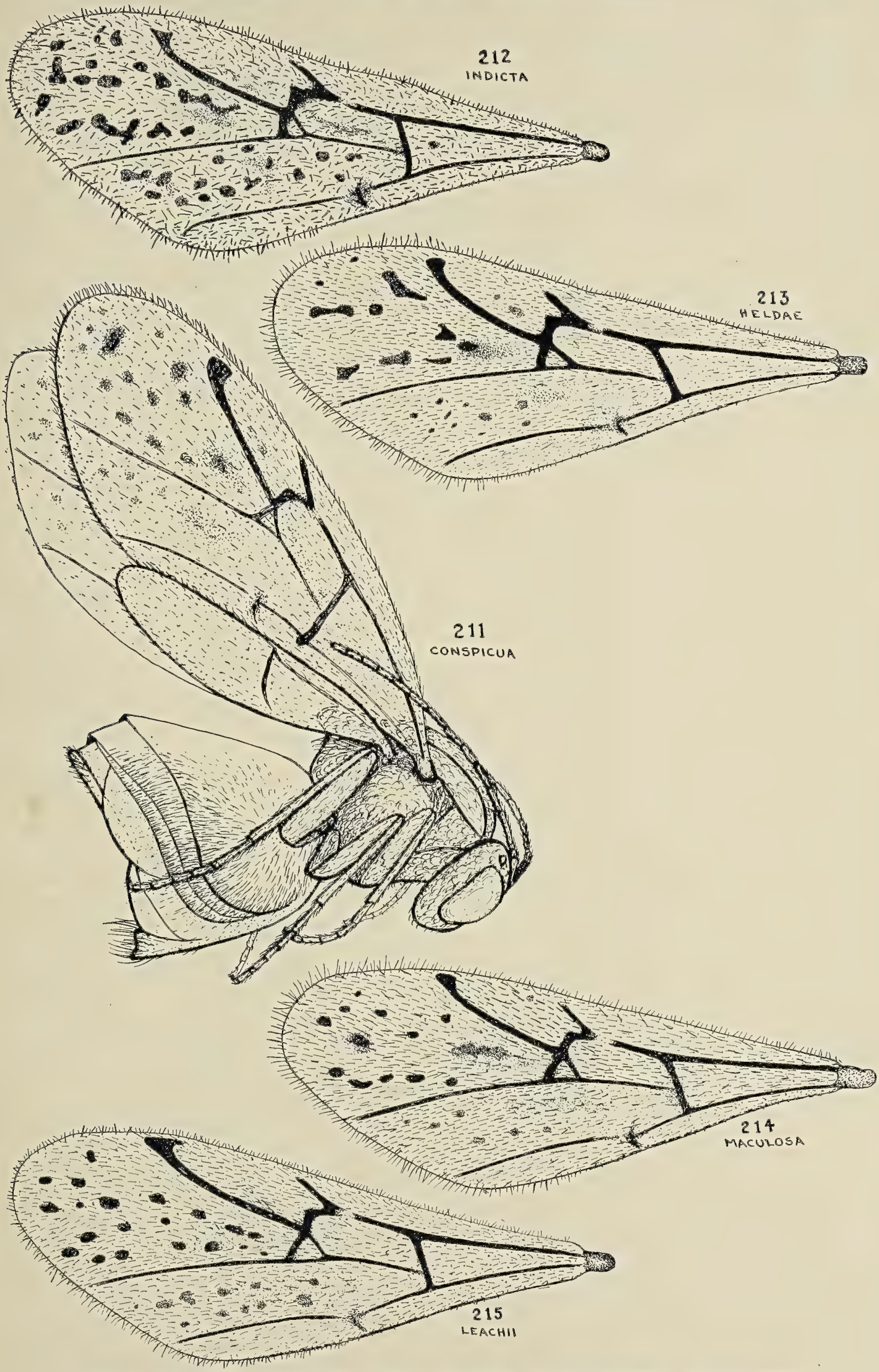
SUBGENUS BESBICUS

Fig. 211. Adult, *C. multipunctata conspicua,* paratype, Napa, Calif., *Q. lobata,* F. A. Leach, in Kinsey coll. X 15

FRONT WINGS

From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 212. *C. multipunctata indicta,* paratype, Kelseyville, Calif., *Q. Douglasii,* P. Schulthess, in Kinsey coll.
Fig. 213. *C. multipunctata heldae,* Kelseyville, Calif., *Q. lobata,* P. Schulthess, in Kinsey coll.
Fig. 214. *C. maculosa maculosa,* paratype, Sequoia National Park, Calif., *Q. dumosa,* Weld, in Kinsey coll.
Fig. 215. *C. mirabilis leachii,* paratype, Yorkville, Calif., *Q. garryana,* F. A. Leach, in Kinsey coll.



FIGS. 211-215 ADULT AND WINGS, SUBGENUS BESBICUS
Note uniformity in wing characters within the subgenus.

35—45639

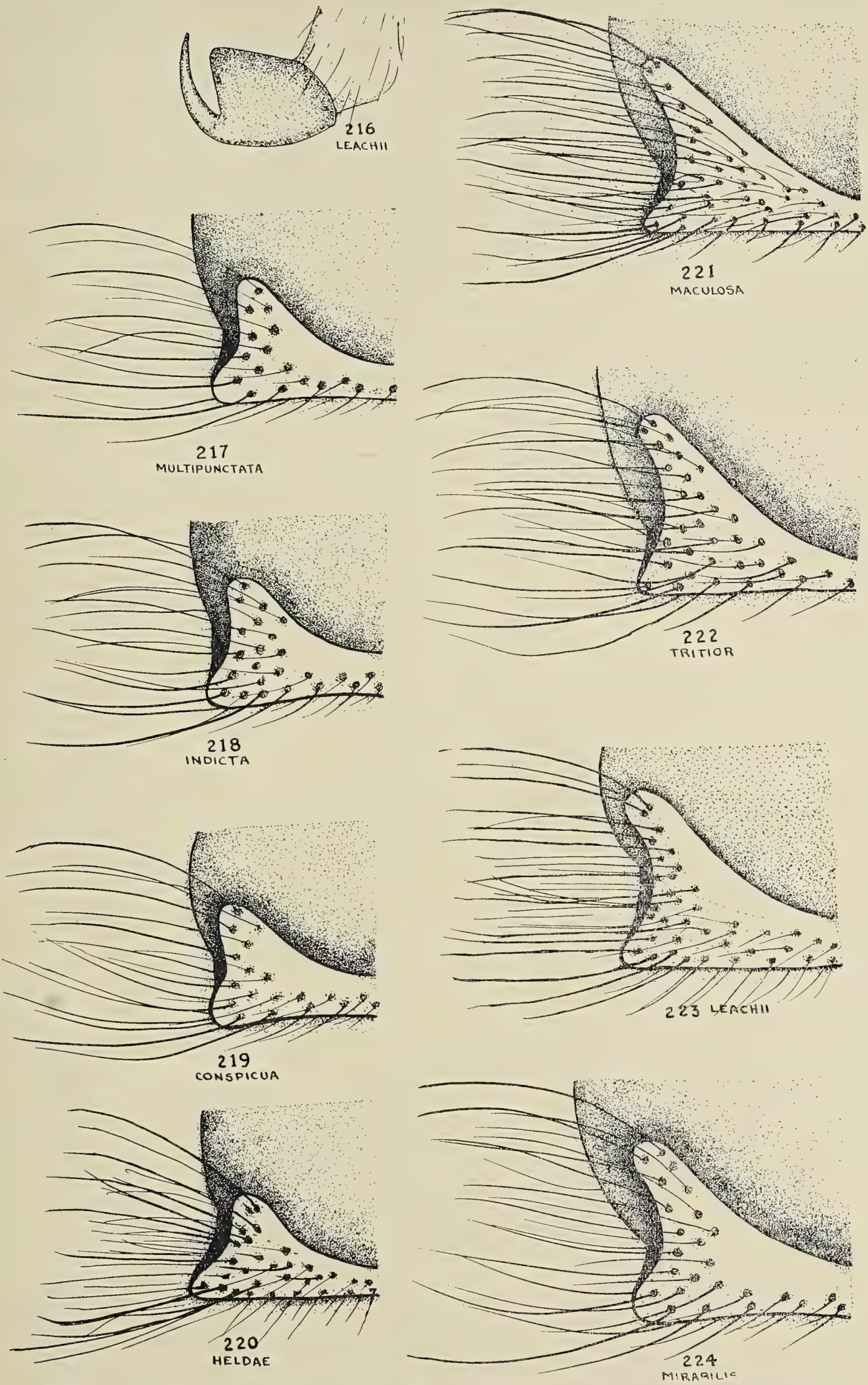
SUBGENUS BESBICUS

Fig. 216. Tarsal claw, *C. mirabilis leachii*, paratype, Yorkville, Calif., *Q. garryana*, F. A. Leach, in Kinsey coll.

HYPOPYGIAL SPINES

From adults uniformly enlarged to 150. mm., so relative sizes may be seen by direct comparisons of drawings

Fig. 217. *C. multipunctata multipunctata*, Diablo, Calif., *Q. Douglasii*, F. A. Leach, in Kinsey coll.
Fig. 218. *C. multipunctata indicta*, holotype, Kelseyville, Calif., *Q. Douglasii*, P. Schulthess, in Kinsey coll.
Fig. 219. *C. multipunctata conspicua*, holotype, Napa, Calif., *Q. lobata*, F. A. Leach, in Kinsey coll.
Fig. 220. *C. multipunctata heldae*, Kelseyville, Calif., *Q. lobata*, P. Schulthess, in Kinsey coll.
Fig. 221. *C. maculosa maculosa*, paratype, Sequoia National Park, Calif., *Q. dumosa*, Weld, in Kinsey coll.
Fig. 222. *C. maculosa tritior*, holotype, Kelseyville, Calif., *Q. durata*, P. Schulthess, in Kinsey coll.
Fig. 223. *C. mirabilis leachii*, holotype, Yorkville, Calif., *Q. garryana*, F. A. Leach, in Kinsey coll.
Fig. 224. *C. mirabilis mirabilis*, paratype, Portland, Oregon, E. O. Hovey, *Q. garryana*, in Kinsey coll.



FIGS. 216-224. HYPOPYGIAL SPINES, SUBGENUS BESBICUS

Note uniformity within hereditary stocks.

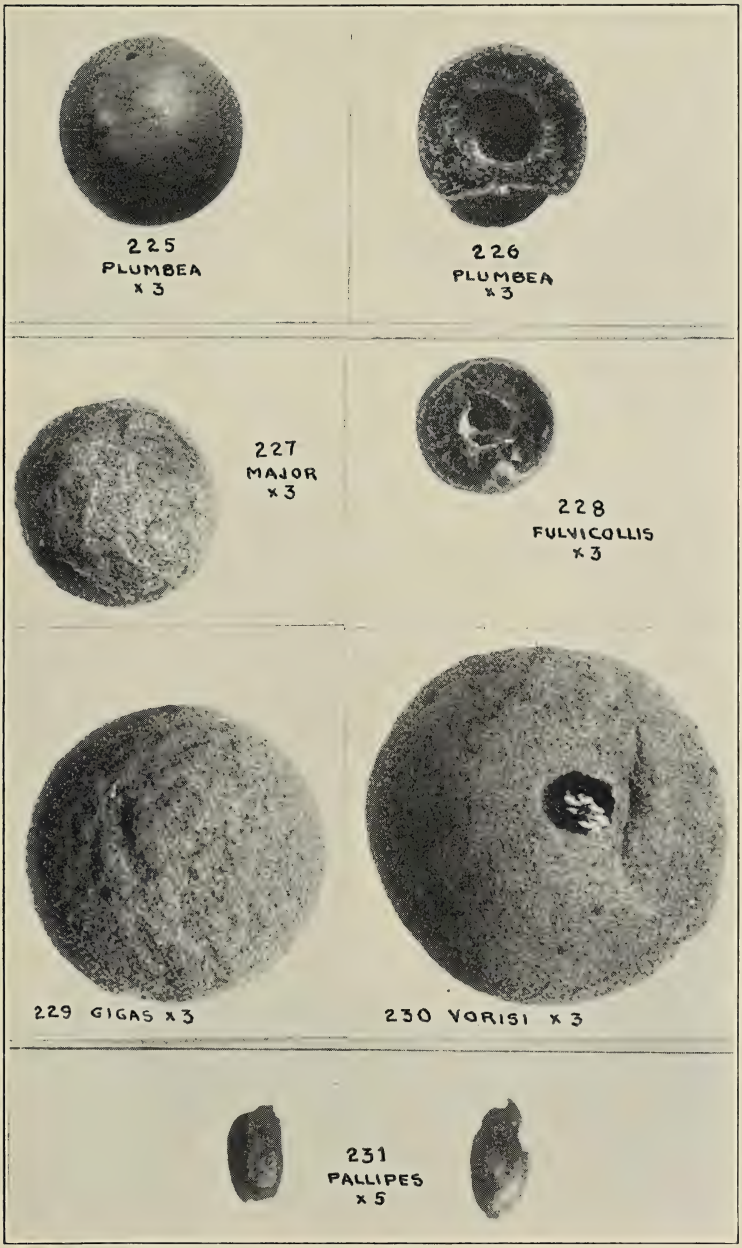
GALLS, SUBGENUS PHILONIX

AGAMIC GALLS, X 3

Fig. 225. *C. plumbea,* paratype, Esperaro Canyon in Santa Catalina Mts., Ariz., *Q. oblongifolia,* Hofer and Edmonston, in Kinsey coll.
Fig. 226. *C. plumbea,* Sabino Trail in Santa Catalina Mts., Ariz., *Q. oblongifolia,* Kinsey coll.
Fig. 227. *C. fulvicollis major,* paratype, America, Ill., *Q. alba,* Kinsey coll.
Fig. 228. *C. fulvicollis fulvicollis,* paratype of Bassett's *gillettei,* Ionia Co., Mich., or Ames, Iowa, *Q. alba,* C. P. Gillette, in Kinsey coll.
Fig. 229. *C. fulvicollis gigas,* Winfield, Kans., *Q. Mühlenbergii,* R. Voris, in Kinsey coll.
Fig. 230. *C. fulvicollis vorisi,* paratype, Winfield, Kans., *Q. macrocarpa,* R. Voris, in Kinsey coll.

BISEXUAL GALLS, X 5

Fig. 231. *C. fulvicollis fulvicollis* bisex. form *pallipes,* Charlestown, Ind., *Q. alba,* E. W. Spieth, in Kinsey coll.



FIGS. 225-231. GALLS, SUBGENUS PHILONIX

Agamic galls uniform; bisexual galls in figure 231.

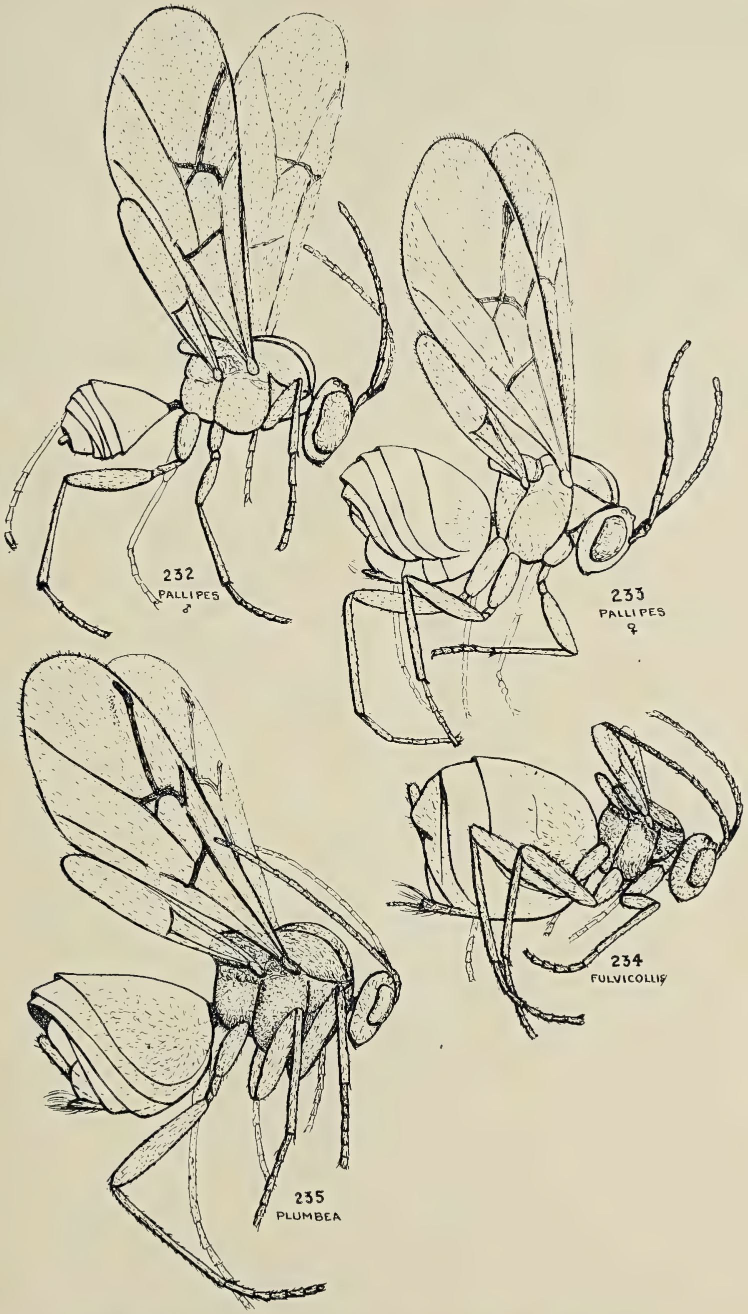
ADULTS, SUBGENUS PHILONIX

X 15

Figs. 232-233. *C. fulvicollis fulvicollis* bisex. form *pallipes,* Charlestown, Ind., *Q. alba,* E. W. Spieth, in Kinsey coll. Male = fig. 232. Female = fig. 233.

Fig. 234. *C. fulvicollis fulvicollis* agamic form *fulvicollis,* Bennett, N.J., *Q. alba,* Kinsey coll.

Fig. 235. *C. plumbea,* paratype, Esperaro Canyon in Santa Catalina Mts., Ariz., *Q. oblongifolia,* Hofer and Edmonston, in Kinsey coll.



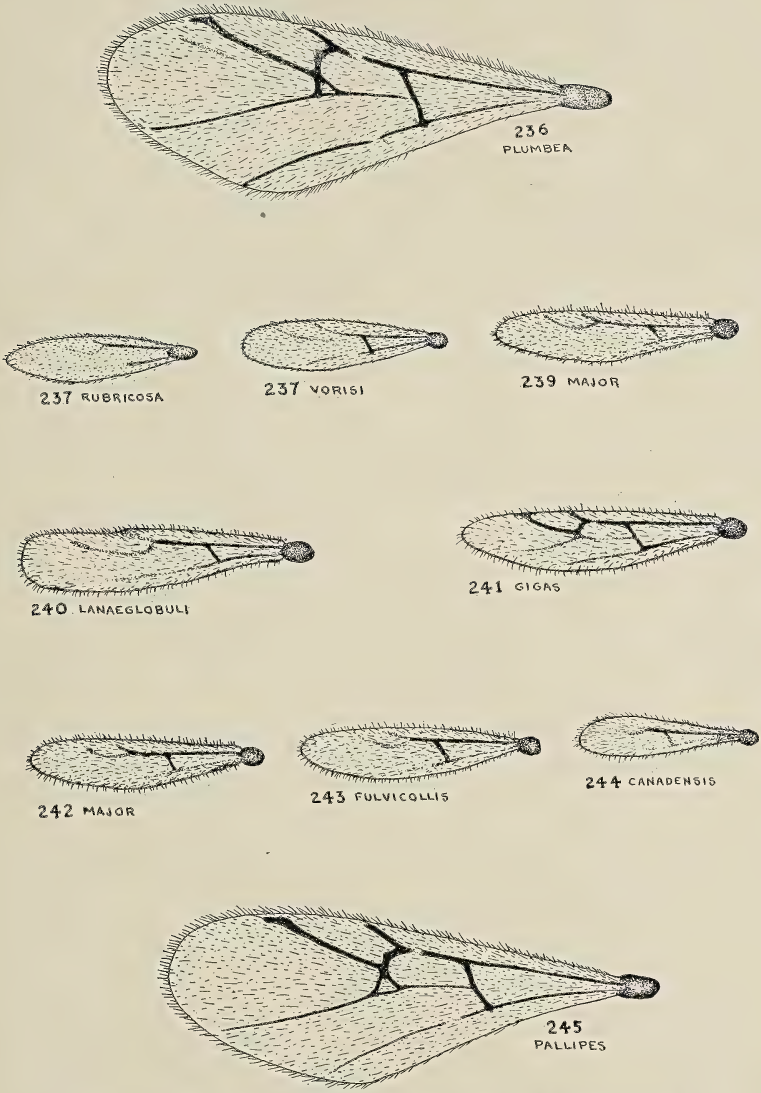
FIGS. 232-235. ADULTS, SUBGENUS PHILONIX

Long-winged and short-winged relatives (figs. 234-235) differ no more than alternate generations of one species (figs. 232-234).

FRONT WINGS, SUBGENUS PHILONIX

From adults uniformly enlarged to 50 mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 236. *C. plumbea*, paratype, Esperaro Canyon in Santa Catalina Mts., Ariz., *Q. oblongifolia,* Hofer and Edmonston, in Kinsey coll.
Fig. 237. *C. fulvicollis rubricosa,* holotype, Charleston, Tenn., *Q. alba,* Kinsey coll.
Fig. 238. *C. fulvicollis vorisi,* holotype, Winfield, Kans., *Q. macrocarpa,* R. Voris, in Kinsey coll.
Fig. 239. *C. fulvicollis major,* holotype, America, Ill., *Q. alba,* Kinsey coll.
Fig. 240. *C. fulvicollis lanaeglobuli,* holotype, eastern Florida, *Q. bicolor,* W. H. Ashmead, in U.S. Nat. Mus.
Fig. 241. *C. fulvicollis gigas,* paratype, Hoxie, Ark., *Q. lyrata,* L. H. Weld, in Kinsey coll.
Fig. 242. *C. fulvicollis fulvicollis,* holotype of Fitch's *nigricollis,* (Albany?) N.Y., A. Fitch, in U.S. Nat. Mus. Incorrectly labelled *major.*
Fig. 243. *C. fulvicollis fulvicollis* agamic form *fulvicollis,* holotype, (Albany?) N.Y., A. Fitch, in U.S. Nat. Mus.
Fig. 244. *C. fulvicollis canadensis,* holotype, Traverse City, Mich., *Q. alba,* Kinsey coll.
Fig. 245. *C. fulvicollis fulvicollis* bisex. form *pallipes,* Charlestown, Ind., *Q. alba,* E. W. Spieth, in Kinsey coll.



FIGS. 236-245. WING MUTANTS IN PHILONIX

SUBGENUS PHILONIX

HYPOPYGIAL SPINES

From adults uniformly enlarged to 150. mm., so sizes of spines may be compared by direct comparisons of drawings

Fig. 246. *C. plumbea,* holotype, Esperaro Canyon in Santa Catalina Mts., Ariz., *Q. oblongifolia,* Hofer and Edmonston, in U.S. Nat. Mus.

Fig. 247. *C. fulvicollis rubricosa,* holotype, Charleston, Tenn., *Q. alba,* Kinsey coll.

Fig. 248. *C. fulvicollis vorisi,* holotype, Winfield, Kans., *Q. macrocarpa,* R. Voris, in Kinsey coll.

Fig. 249. *C. fulvicollis major,* holotype, America, Ill., *Q. alba,* Kinsey coll.

Fig. 250. *C. fulvicollis gigas,* paratype, Hoxie, Ark., *Q. lyrata,* L. H. Weld, in Kinsey coll.

Fig. 251. *C. fulvicollis fulvicollis* bisex. form *pallipes,* holotype, Waterbury, Conn., *Q. alba,* Bassett, in Phila. Acad.

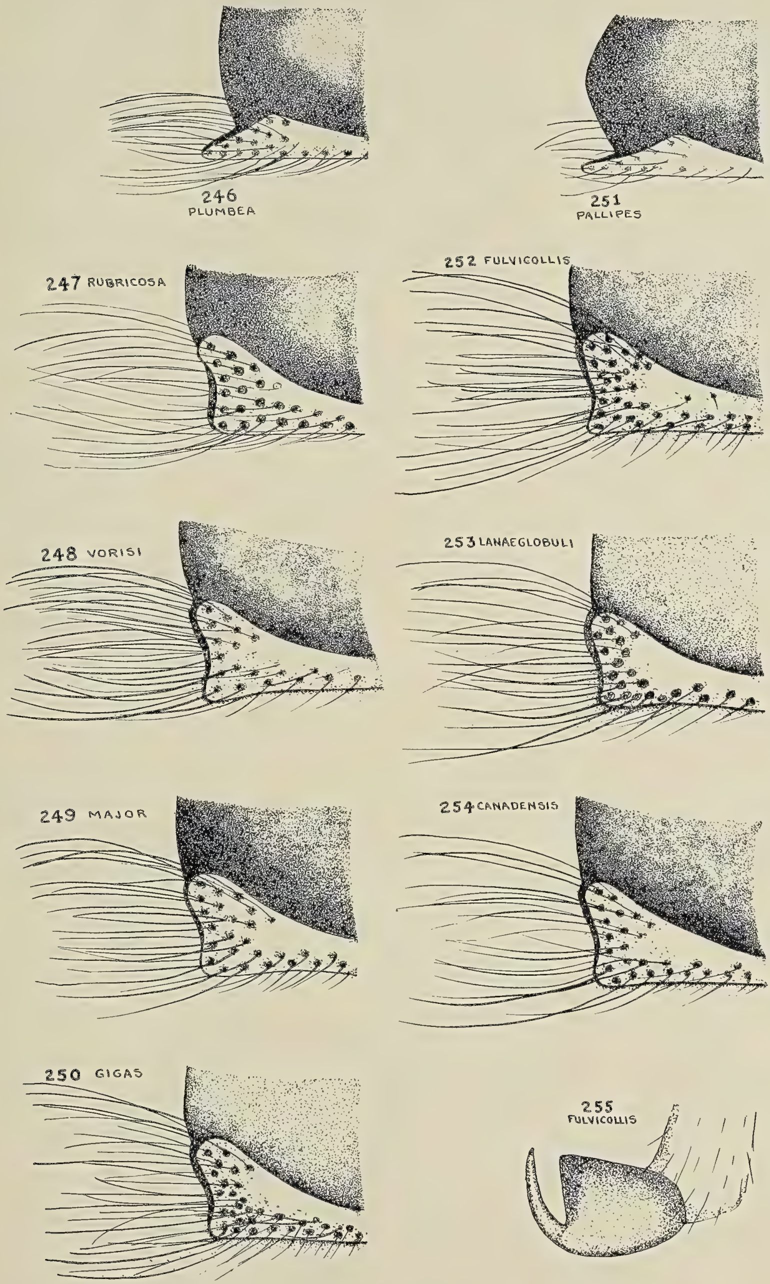
Fig. 252. *C. fulvicollis fulvicollis* agamic form *fulvicollis,* holotype, (Albany?) N.Y., A. Fitch, in U.S. Nat. Mus.

Fig. 253. *C. fulvicollis lanaeglobuli,* holotype, eastern Florida, *Q. bicolor,* W. H. Ashmead, in U.S. Nat. Mus.

Fig. 254. *C. fulvicollis canadensis,* paratype, Traverse City, Mich., *Q. alba,* Kinsey coll.

TARSAL CLAW

Fig. 255. *C. fulvicollis fulvicollis,* paratype of Bassett's *gillettei,* Ionia Co., Mich., or Ames, Iowa, *Q. alba,* C. P. Gillette, in Kinsey coll.



FIGS. 246-255. MUTANT SPINES IN PHILONIX

Normal form in long-winged insects (figs. 246, 251); uniformly modified in short-winged insects (figs. 247-254).

GALLS, SUBGENUS ATRUSCA

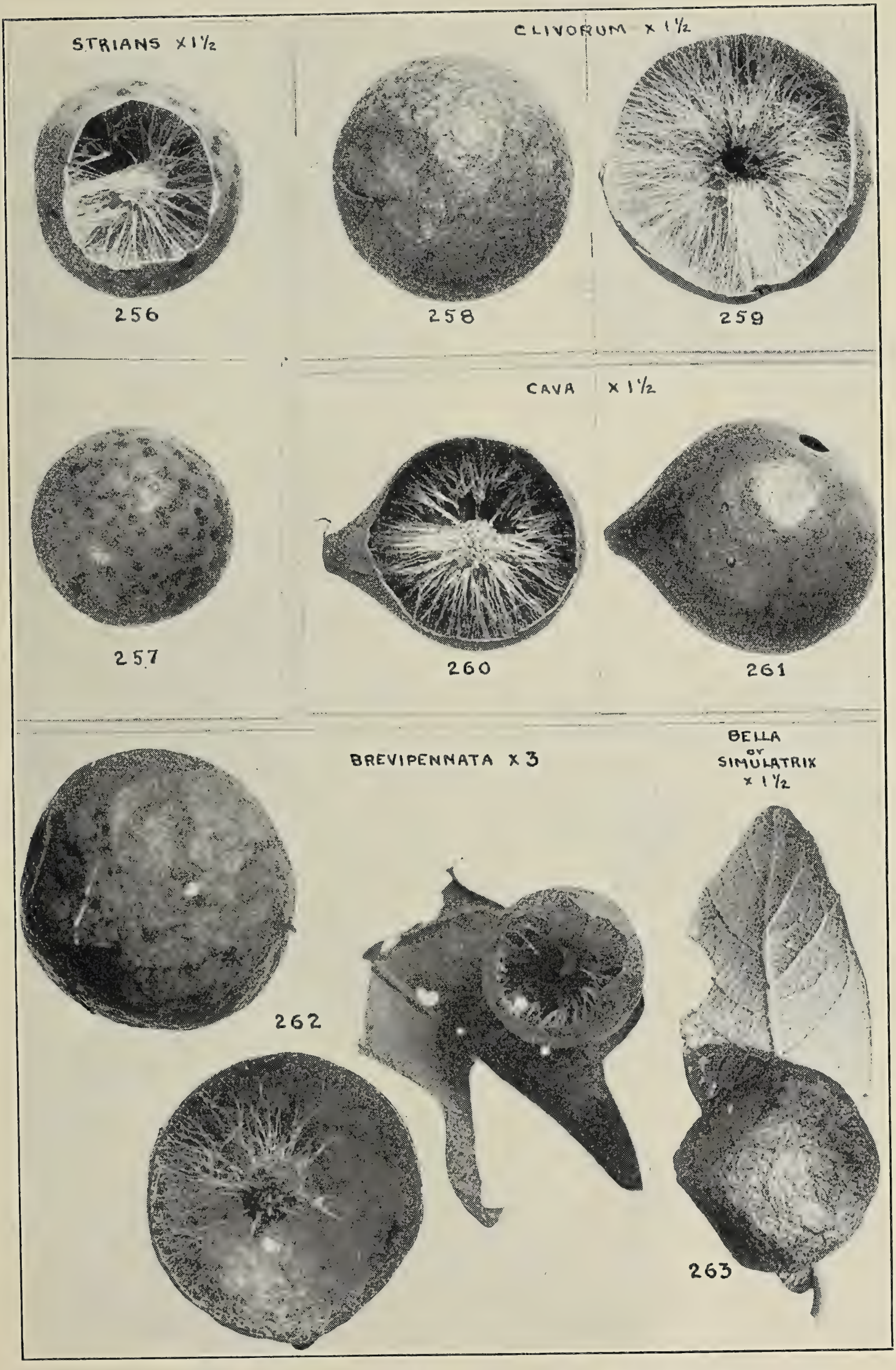
Figs. 256-257. *C. centricola strians,* paratypes, Bonnie, Ill., *Q. stellata,* Kinsey coll. X 1.5

Figs. 258-259. *C. centricola clivorum,* Madisonville, Tenn., *Q. stellata,* Kinsey coll. X 1.5

Figs. 260-261. *C. cava,* Round Rock, Texas, *Q. breviloba,* Kinsey coll. X 1.5

Fig. 262. *C. dugèsi brevipennata,* cotypes of Kinsey's *pellucidus,* Colorado Springs, Colo., W. L. Carpenter, in Mus. Comp. Zool. X 3

Fig. 263. *C. bella bella* or *C. dugèsi simulatrix* (galls indistinguishable), Soledad Canyon in Organ Mts., N.M., *Q. arizonica,* L. H. Bridewell, in Kinsey coll. X 1.5



FIGS. 256-263. GALLS, SUBGENUS ATRUSCA

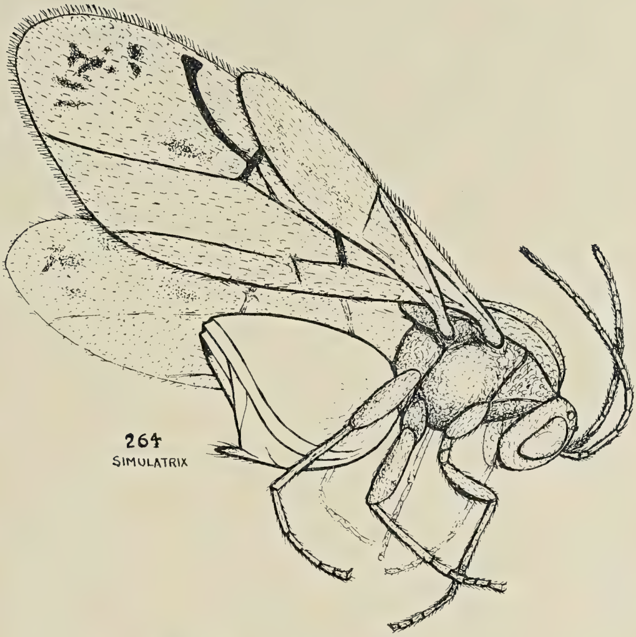
Similar in form as well as internal structure.

ADULTS, SUBGENUS ATRUSCA

X 15

Fig. 264. *C. dugèsi simulatrix,* holotype, Hillsboro, N.M., *Q. grisea,* Kinsey coll.

Fig. 265. *C. dugèsi pupoides,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.



264
SIMULATRIX

265
PUPOIDES

FIGS. 264-265. ADULTS, SUBGENUS ATRUSCA
Showing type of mutant species (fig. 265) peculiar to this subgenus.

FRONT WINGS, SUBGENUS ATRUSCA

From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 266. *C. dugèsi simulatrix,* holotype, Hillsboro, N.M., *Q. grisea,* Kinsey coll.

Fig. 267. *C. dugèsi pupoides,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 268. *C. dugèsi dugèsi,* San Luis Potosi, Mexico, Ed. Palmer, in Kinsey coll.

Fig. 269. *C. centricola clivorum,* holotype, Coolville, Ohio, *Q. stellata,* Kinsey coll.

Fig. 270. *C. cava,* paratype, near Austin, Texas, *Q. breviloba,* L. H. Weld, in Kinsey coll.

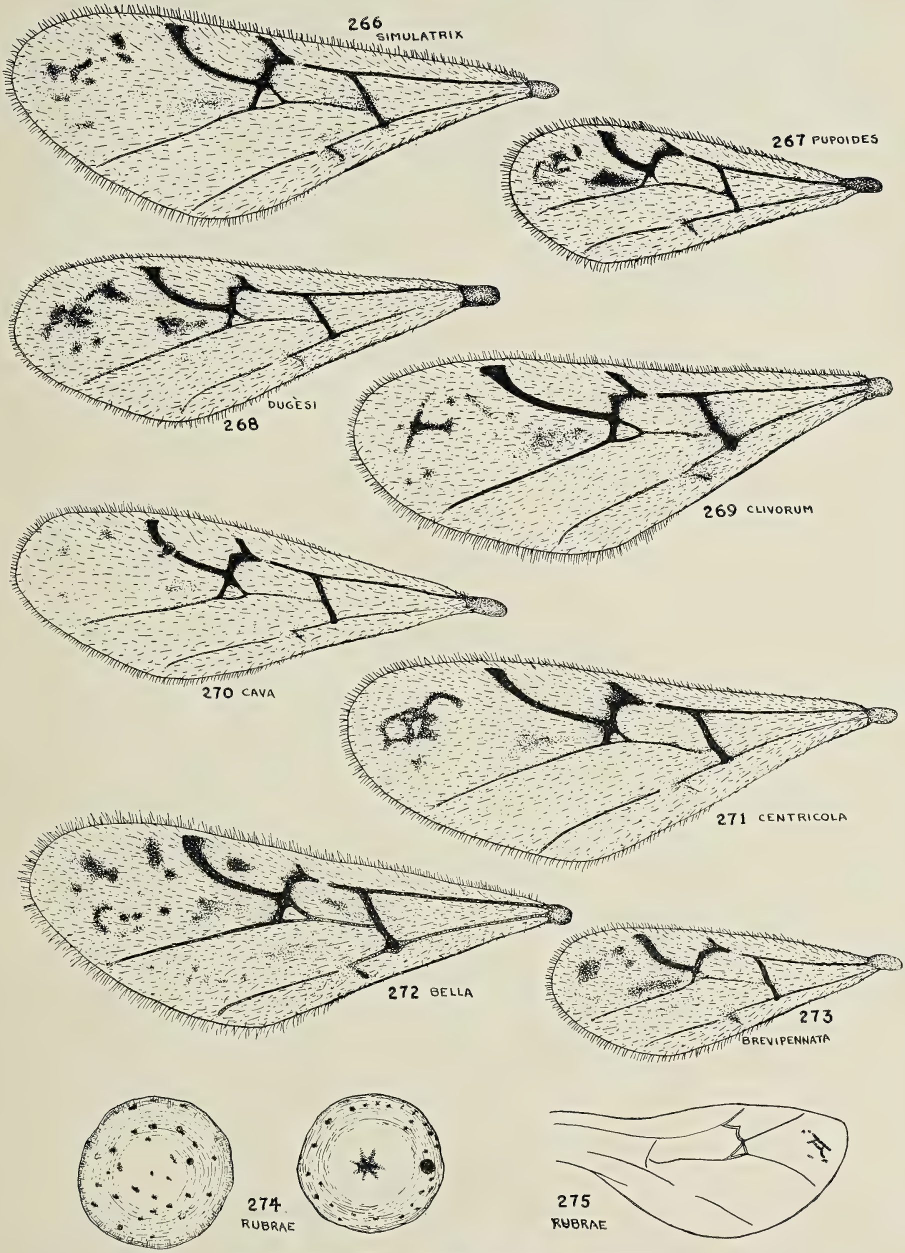
Fig. 271. *C. centricola centricola,* Annapolis, Mo., *Q. stellata,* E. S. Anderson, in Kinsey coll.

Fig. 272. *C. bella bella,* Alamogordo, N.M., *Q. arizonica,* Kinsey coll.

Fig. 273. *C. bella brevipennata,* paratype of Kinsey's *pellucidus,* Colorado Springs, Colo., W. L. Carpenter, in Kinsey coll.

Fig. 274. Galls, *C. centricola rubrae,* (Texas?), Van Zandt, in Berlin Mus. Redrawn after Karsch, 1880: figs. 4a-4b.

Fig. 275. Front wing, *C. centricola rubrae,* (Texas?), Van Zandt, in Berlin Mus. Redrawn after Karsch, 1880: fig. 4.



FIGS. 266-275. WINGS IN ATRUSCA

Showing species of mutant origin.

SUBGENUS ATRUSCA

HYPOPYGIAL SPINES

From adults uniformly enlarged to 150. mm., so sizes of spines may be compared by direct comparisons of drawings

Fig. 276. *C. dugèsi simulatrix,* holotype, Hillsboro, N.M., *Q. grisea,* Kinsey coll.

Fig. 277. *C. dugèsi dugèsi,* San Luis Potosi, Mexico, Ed. Palmer, in Kinsey coll.

Fig. 278. *C. dugèsi brevipennata,* Las Vegas, N.M., *Q. fendleri,* L. H. Weld, in Kinsey coll.

Fig. 279. *C. dugèsi pupoides,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 280. *C. bella bella,* Magdalena, N.M., *Q. grisea,* L. H. Weld, in Kinsey coll.

Fig. 281. *C. bella congesta,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 282. *C. bella vanescens,* holotype, Globe, Ariz., *Q. grisea,* Kinsey coll.

Fig. 283. *C. cava,* paratype, near Austin, Texas, *Q. breviloba,* L. H. Weld, in Kinsey coll.

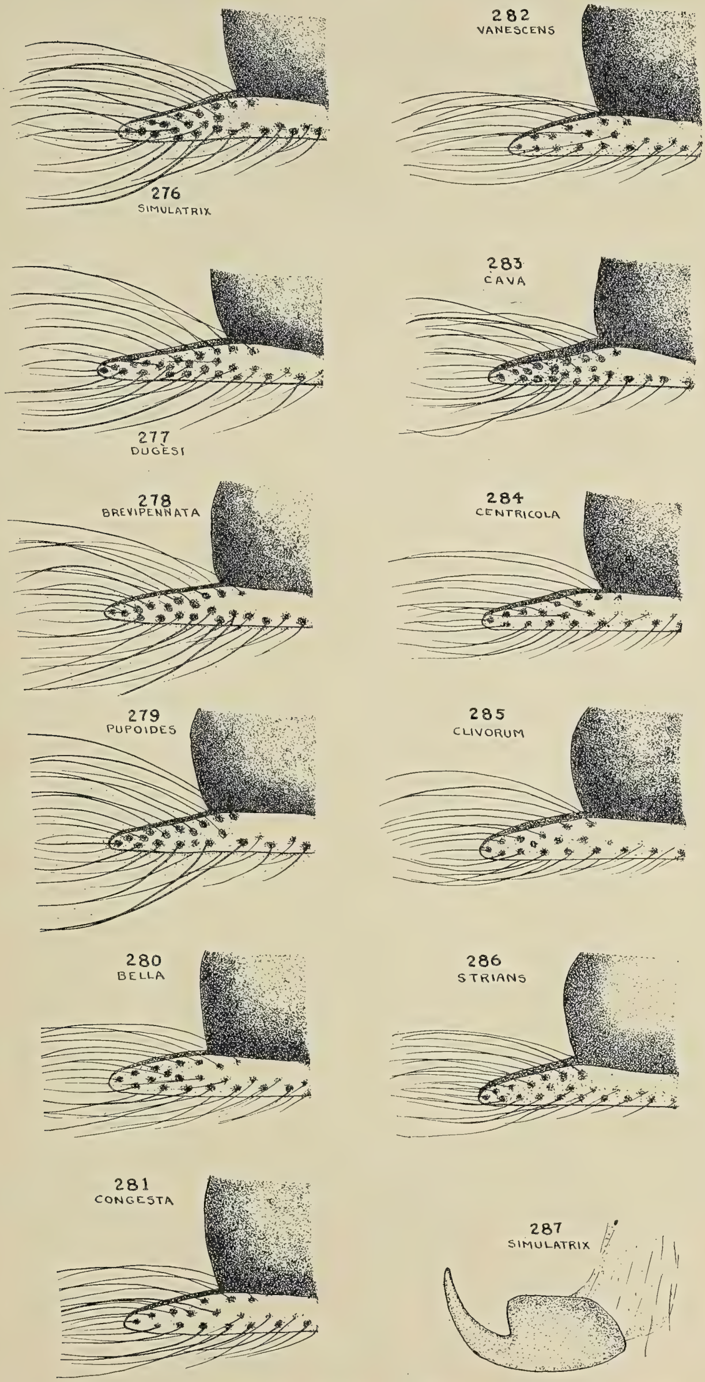
Fig. 284. *C. centricola centricola,* Farmingdale, N.Y., *Q. stellata,* Angus, in Kinsey coll.

Fig. 285. *C. centricola clivorum,* holotype, Coolville, Ohio, *Q. stellata,* Kinsey coll.

Fig. 286. *C. centricola strians,* holotype, Bonnie, Ill., *Q. stellata,* Kinsey coll.

TARSAL CLAW

Fig. 287. *C. dugèsi simulatrix,* holotype, Hillsboro, N.M., *Q. grisea,* Kinsey coll.



FIGS. 276-287. HYPOPYGIAL SPINES IN ATRUSCA

Complete uniformity within the subgenus, including species with reduced wings.

GALLS, SUBGENUS ACRASPIS

Figs. 288-289. *C. conica,* paratypes, Globe, Ariz., *Q. grisea,* Kinsey coll. X 3

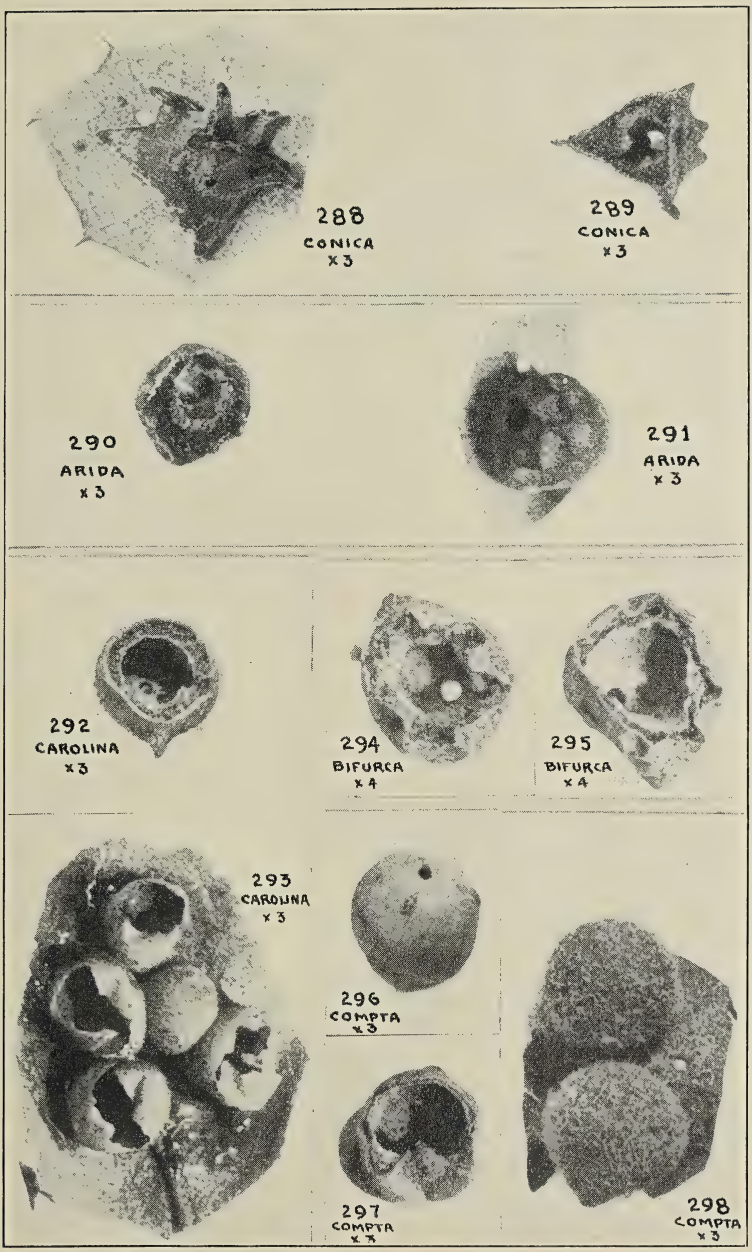
Figs. 290-291. *C. arida,* paratypes, Alpine, Texas, *Q. grisea,* Kinsey coll. X 3

Figs. 292-293. *C. mellea carolina,* Carmel, N.J., *Q. stellata,* Kinsey coll. X 3

Figs. 294-295. *C. mellea bifurca,* paratypes, Picayune, Miss., *Q. stellata,* W. E. Smith, in Kinsey coll. X 4

Figs. 296-297. *C. mellea compta,* Austin, Texas, *Q. stellata,* Kinsey coll. X 3

Fig. 298. *C. mellea compta,* paratype, Austin, Texas, *Q. stellata,* Patterson no. 138, in Kinsey coll. X 3



FIGS. 288-298. GALLS, PART OF SUBGENUS ACRASPIS
Compare adults in figures 337-339.

GALLS, SUBGENUS ACRASPIS

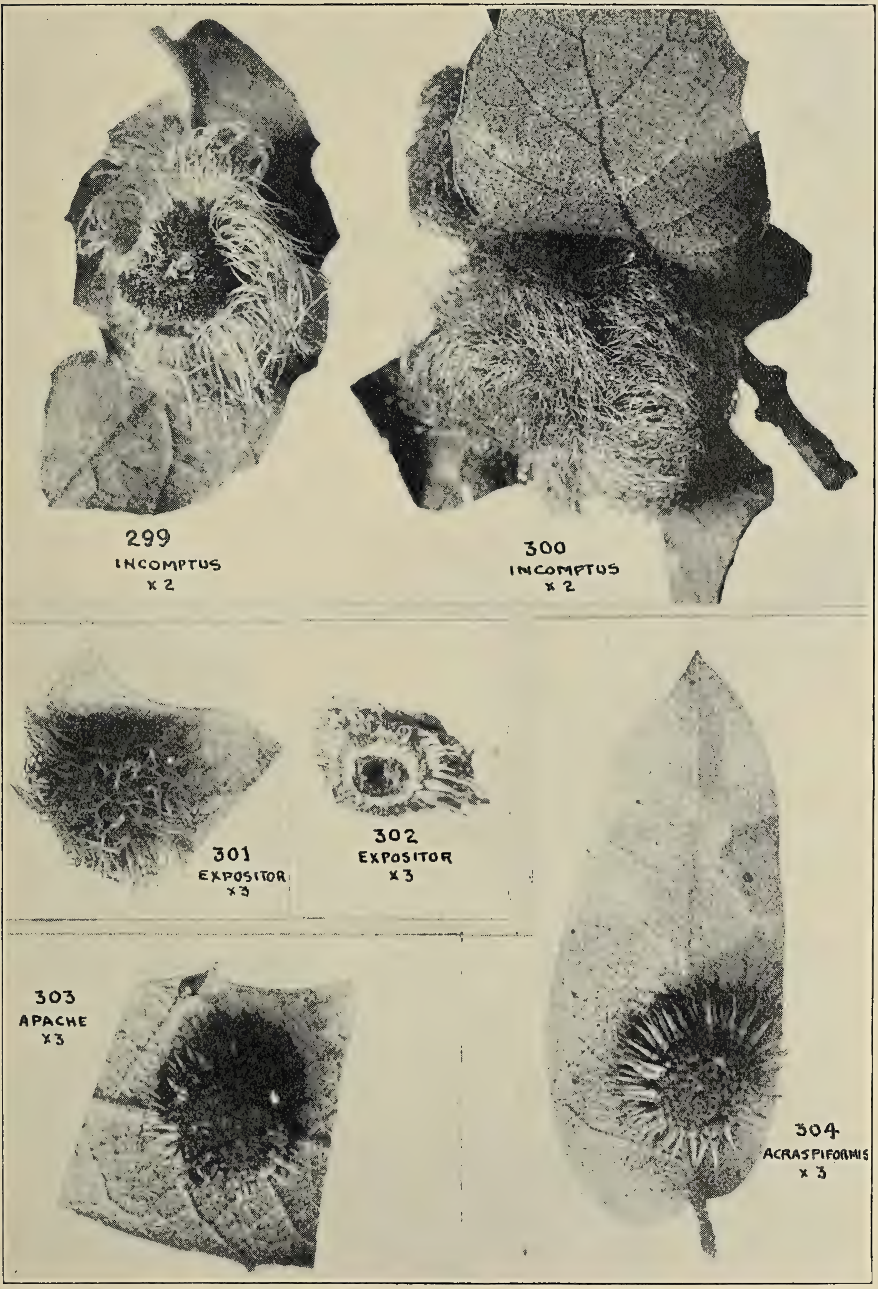
Figs. 299-300. *C. nubila incompta,* paratype, San Luis Potosi, Mexico, *Q. reticulata* (?), Ed. Palmer, in Kinsey coll. X 2

Fig. 301. *C. villosa expositor,* paratype, Alpine, Texas, *Q. grisea,* Kinsey coll. X 3

Fig. 302. *C. villosa expositor,* Soledad Canyon in Organ Mt., N.M., *Q. arizonica,* L. H. Bridewell, in Kinsey coll. X 3

Fig. 303. *C. villosa apache,* paratype, Globe, Arizona, *Q. arizonica,* Kinsey coll. X 3

Fig. 304. *C. villosa acraspiformis,* paratype, Socorro, N.M., *Q. pungens,* L. H. Weld, in Kinsey coll. X 3



FIGS. 299-304. GALLS, PART OF SUBGENUS ACRASPIS

Compare long-winged and short-winged adults (figures 340-341) from similar galls.

GALLS, SUBGENUS ACRASPIS

BISEXUAL FORM, X 5

Figs. 305-306. *C. gemmula gemmula,* paratypes, Waterbury, Conn., *Q. prinoides,* H. F. Bassett, in Kinsey coll.

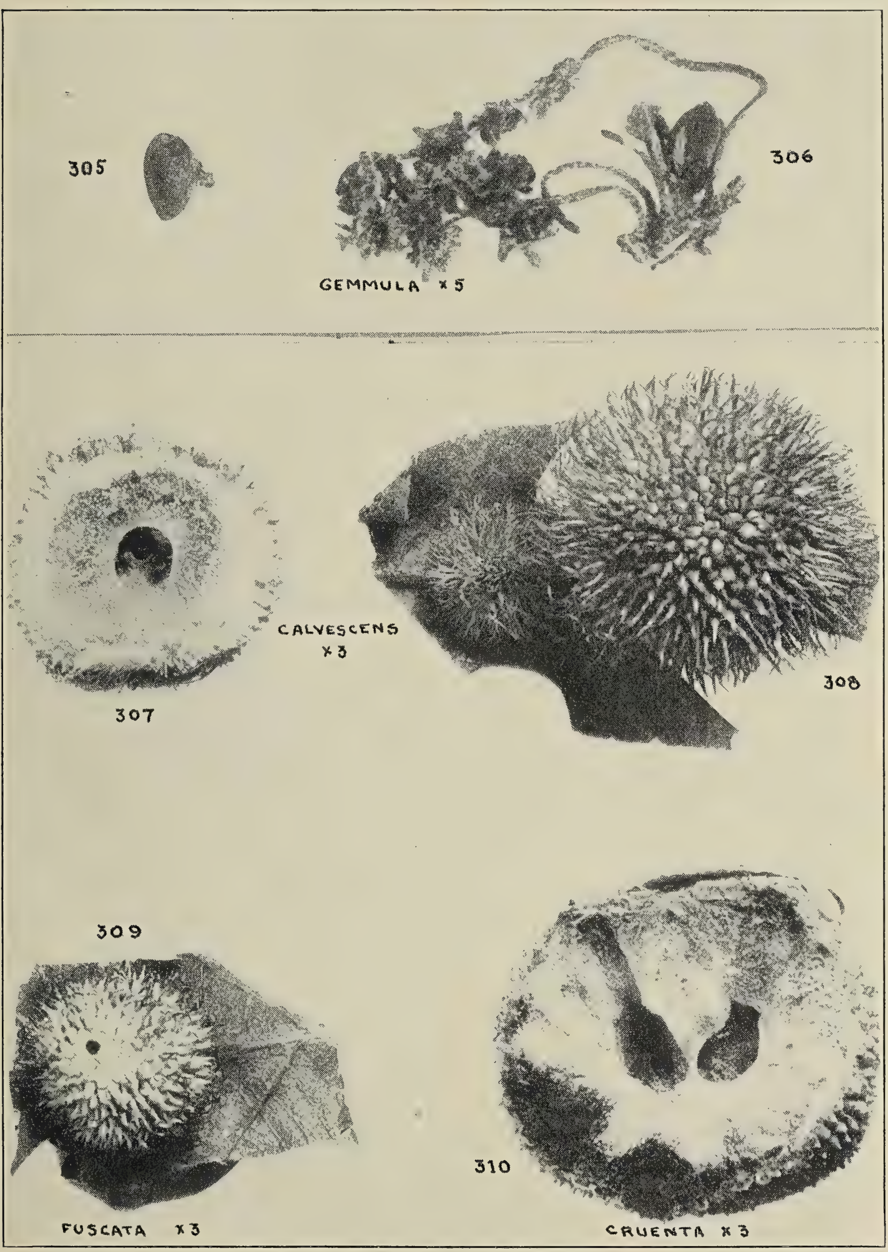
AGAMIC FORMS, X 3

Fig. 307. *C. villosa calvescens,* Farmington, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

Fig. 308. *C. villosa calvescens,* paratypes, Bountiful, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

Fig. 309. *C. gemmula fuscata,* Silverdale, Kans., *Q. Mühlenbergii,* R. Voris, in Kinsey coll.

Fig. 310. *C. gemmula cruenta,* Irwinton, Georgia, *Q. Prinus* var., Kinsey coll.



FIGS. 305-310. BISEXUAL AND AGAMIC GALLS OF ACRASPIS
Varieties of the species *gemmula*.

GALLS, ACRASPIS

BISEXUAL FORM, X 4

Fig. 311. *C. pezomachoides erinacei bicolens,* Charlestown, Ind., *Q. alba,* E. W. Spieth, in Kinsey coll.

AGAMIC FORMS, X 3

Figs. 312-315. *C. pezomachoides erinacei,* Nashville, Ind., *Q. alba,* Kinsey coll. Showing typical gall variation in a variety of hybrid origin.

Fig. 316. *C. hirta macrescens,* Big Rapids, Mich., *Q. macrocarpa,* Kinsey coll.

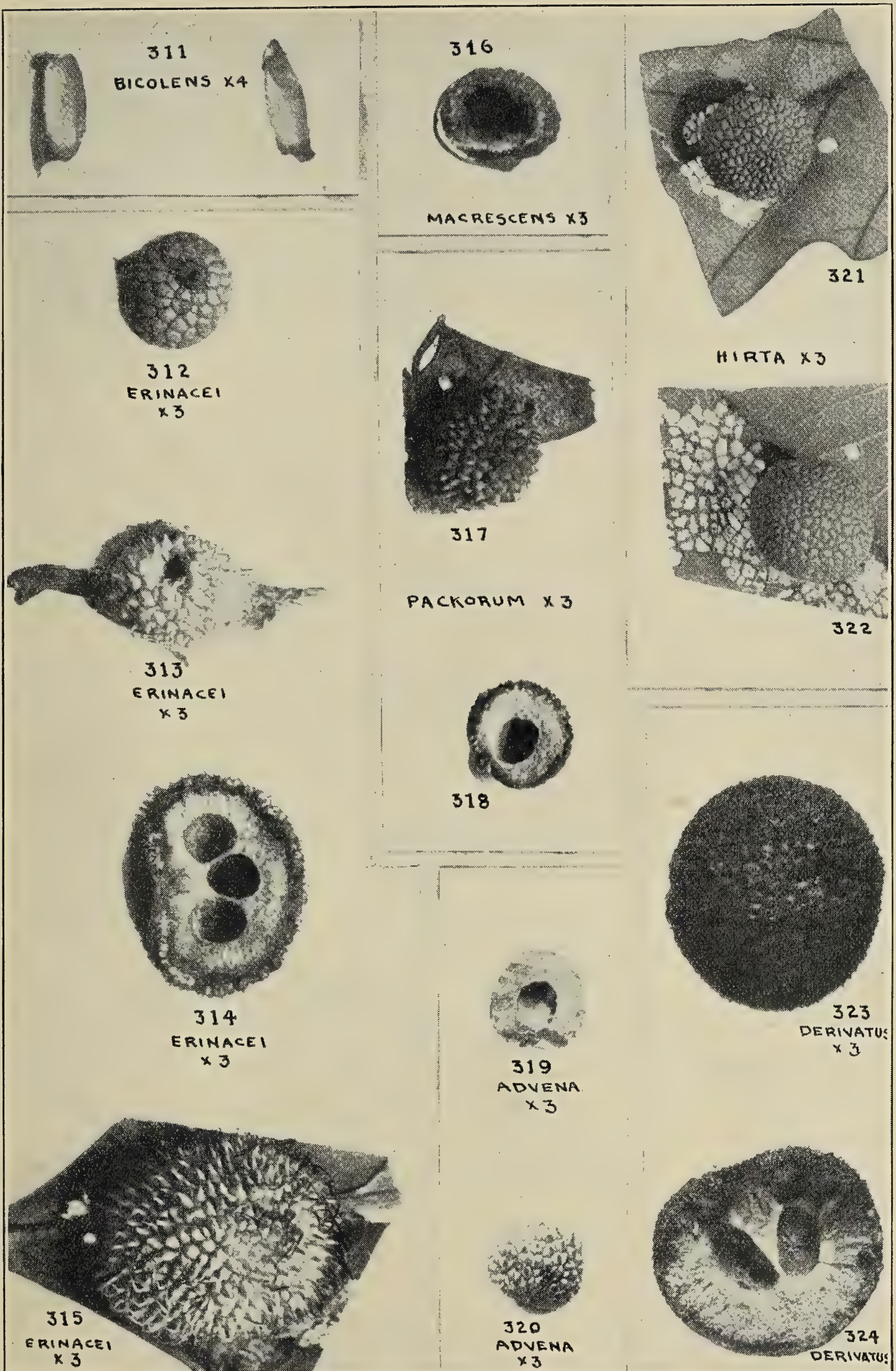
Figs. 317-318. *C. hirta packorum,* Farmington, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

Figs. 319-320. *C. pezomachoides advena,* paratypes, Oakdale, Tenn., *Q. alba,* Kinsey coll.

Figs. 321-322. *C. hirta hirta,* paratypes, Waterbury, Conn., *Q. Prinus,* H. F. Bassett, in Kinsey coll.

Fig. 323. *C. pezomachoides derivatus,* Barnesville, Georgia, *Q. alba,* Kinsey coll.

Fig. 324. *C. pezomachoides derivatus,* Maynardsville, Tenn., *Q. alba,* Kinsey coll.



FIGS. 311-324. GALLS, TWO SPECIES OF ACRASPIS

Bisexual galls (fig. 311). Agamic galls of *C. pezomachoides* varieties (figs. 312-315, 319-320, 323-324); and of *C. hirta* (figs. 316-318, 321-322). Note variation within hybrid variety *erinacei* (figs. 312-315).

GALL DIAGRAMS, SUBGENUS ACRASPIS

X 6

Fig. 325. *C. nubila russa*, showing wool-like hairs on epidermis, collenchyma (and nutritive?) zones.

Fig. 326. *C. villosa expositor*, showing stiff hairs on epidermis, collenchyma, (and nutritive?) zones.

Fig. 327. *C. gemmula gemmula* agamic form *prinoides*, showing stiff spines on epidermis, thick collenchyma, (and nutritive?) zones.

Fig. 328. *C. pezomachoides erinacei* agamic form *erinacei*, showing spiny form of gall.

Fig. 329. *C. hirta macrescens*, showing faceted surface derived from swollen bases of spines on epidermis, and collenchyma (and nutritive?) zones.

Fig. 330. *C. villosa acraspiformis*, showing stiff spines on epidermis, collenchyma (and nutritive?) zones.

Fig. 331. *C. pezomachoides erinacei* agamic form *erinacei*, showing naked form of gall.

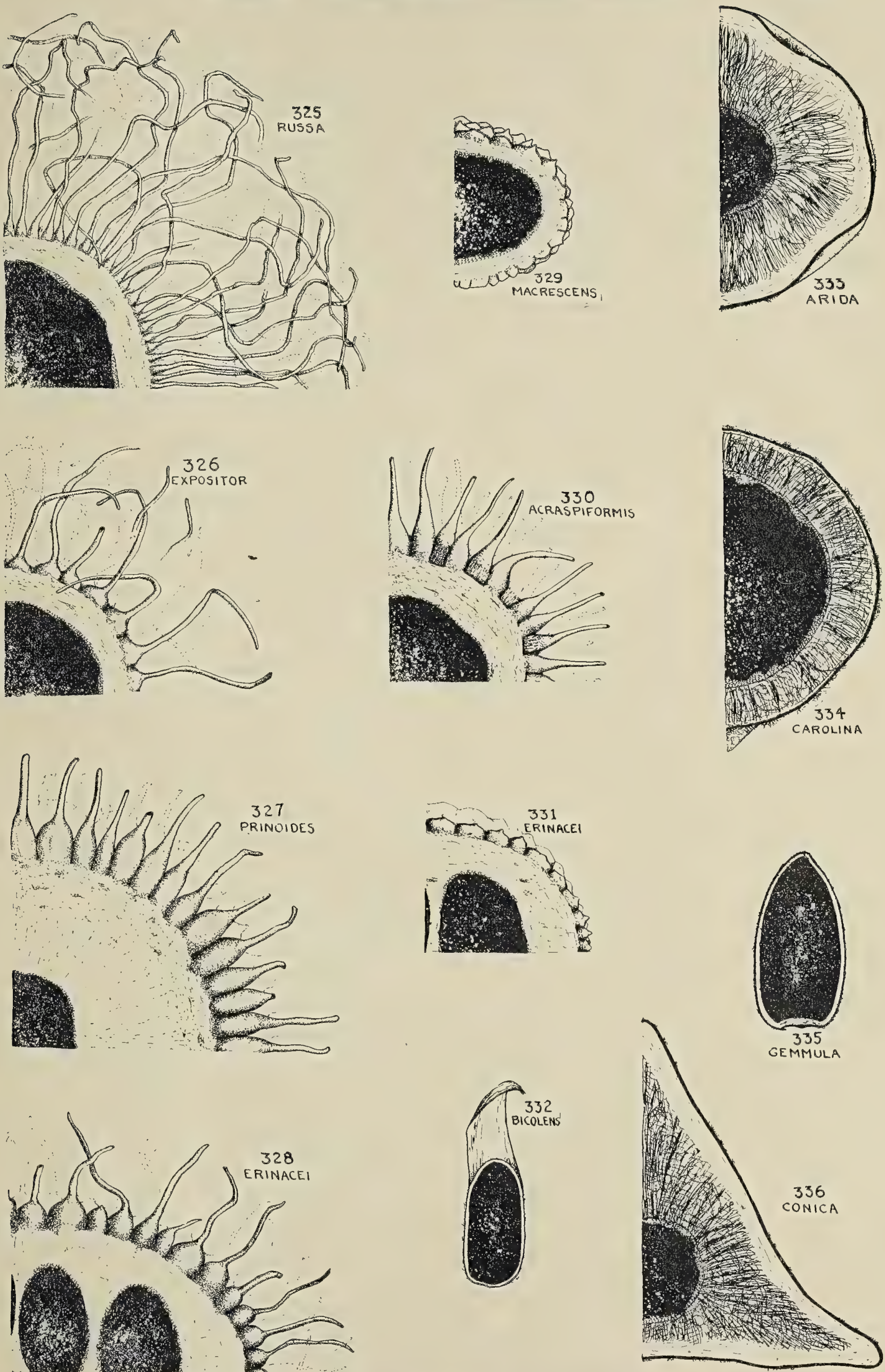
Fig. 332. *C. pezomachoides erinacei* bisex. form *bicolens*, showing epidermis and undifferentiated parenchyma zones.

Fig. 333. *C. arida*, showing epidermis, collenchyma, fibrous parenchyma (protective?), and nutritive zones.

Fig. 334. *C. mellea carolina*, showing epidermis, scant collenchyma, rather fibrous parenchyma (protective?), and nutritive zones.

Fig. 335. *C. gemmula gemmula* bisex. form *gemmula*, showing epidermis and undifferentiated parenchyma zones.

Fig. 336. *C. conica*, showing epidermis, collenchyma, rather fibrous parenchyma (protective?) and nutritive zones.



FIGS. 325-336. GALL DIAGRAMS, SUBGENUS ACRASPIS

Note uniform plan of structure in galls produced by long-winged insects (figs. 325-326, 330) and short-winged insects (figs. 327-329, 331).

ADULTS, SUBGENUS ACRASPIS

X 15

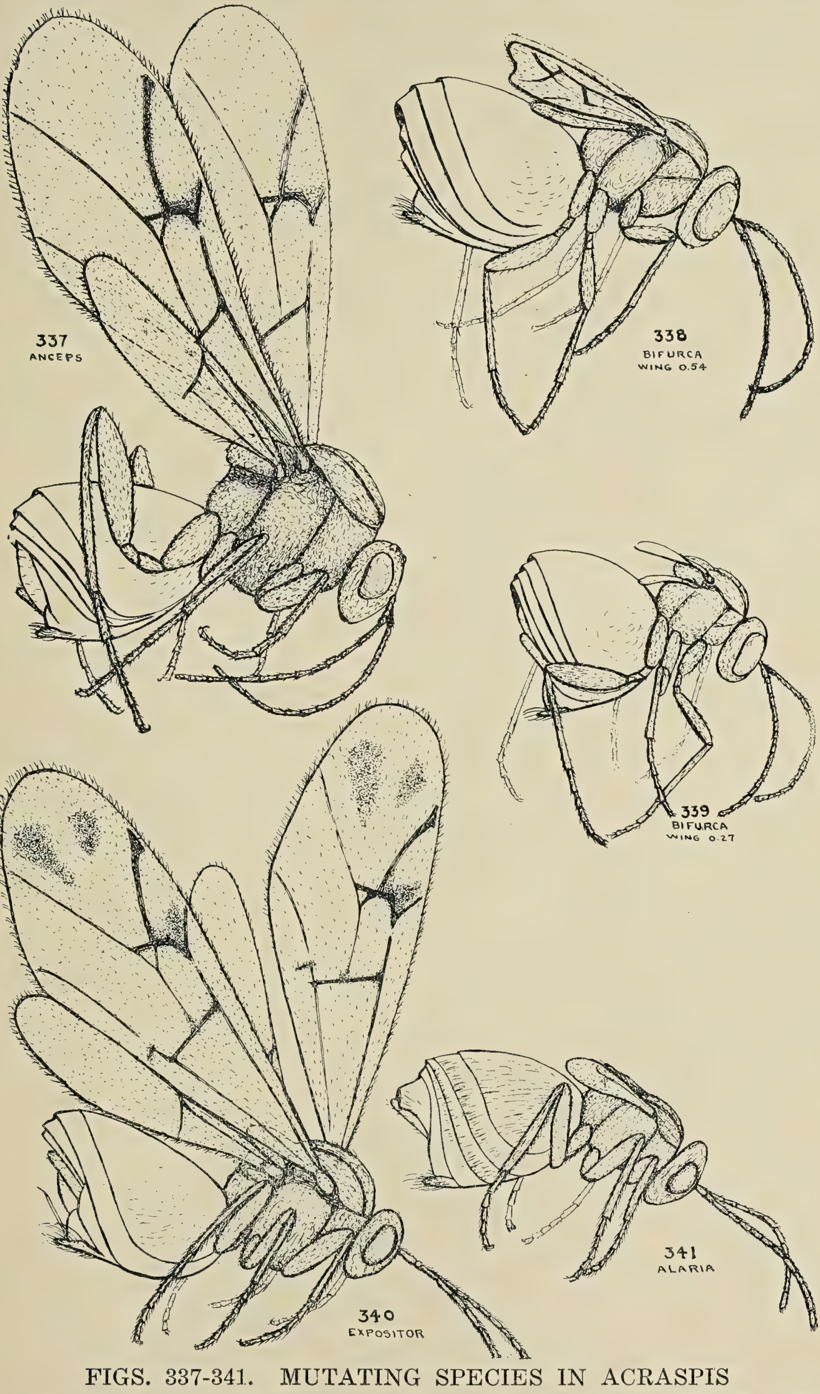
Fig. 337. *C. mellea anceps,* paratype, Austin, Texas, *Q. breviloba,* J. T. Patterson no. 127, in Kinsey coll.

Fig. 338. *C. mellea bifurca,* with wing-body ratio of 0.54, wing bifurcate. From Fender, Georgia, *Q. floridana,* Kinsey coll.

Fig. 339. *C. mellea bifurca,* with wing-body ratio of 0.27, wing pointed. Paratype, Picayune, Miss., *Q. stellata,* W. E. Smith, in Kinsey coll.

Fig. 340. *C. villosa expositor,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 341. *C. villosa alaria,* paratype, Colorado Springs, Colo., *Q. Gambelii,* J. H. Pollock, in Kinsey coll.



FIGS. 337-341. MUTATING SPECIES IN ACRASPIS

Present-day mutants within one variety (figures 337-339) ; and an established species (fig. 341) derived by mutation from long-winged stocks (fig. 340).

ALTERNATING GENERATIONS IN ACRASPIS

ADULTS, X 15

Figs. 342-343. *C. gemmula gemmula* bisex. form *gemmula,* paratypes, Waterbury, Conn., *Q. prinoides,* H. F. Bassett, in Kinsey coll. Female = fig. 342. Male = fig. 343.

Fig. 344. *C. gemmula gemmula* agamic form *prinoides,* Richland, N.J., *Q. prinoides,* Kinsey coll.

FRONT WINGS

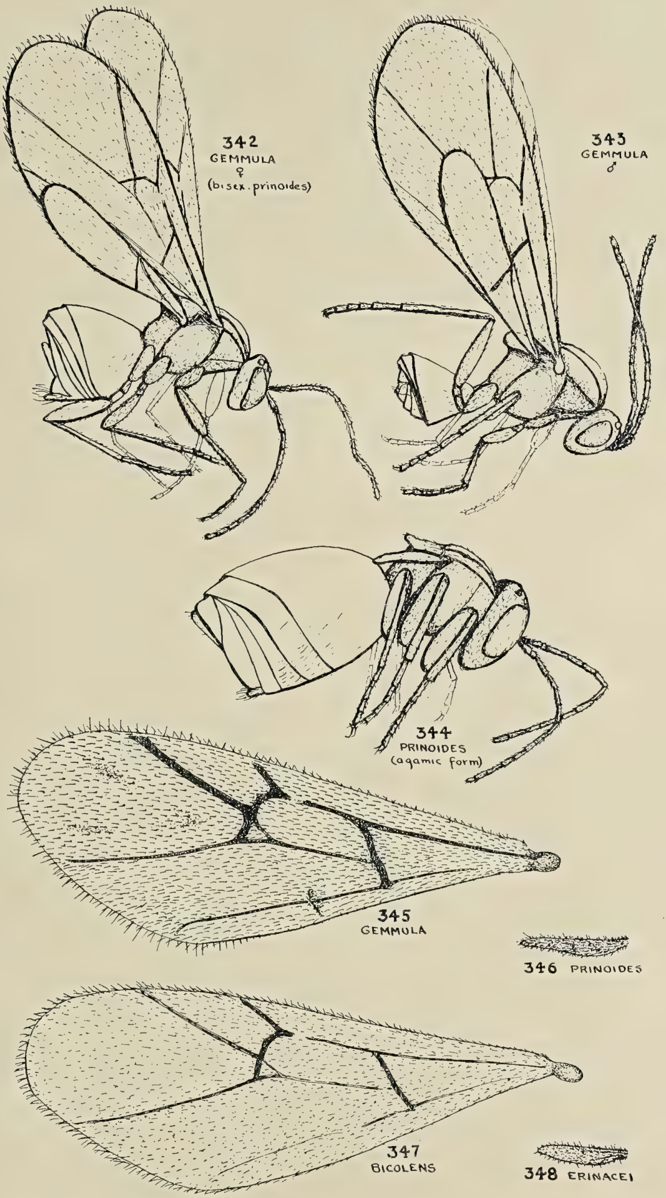
From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of drawings

Fig. 345. *C. gemmula gemmula* bisex. form *gemmula,* paratype, Waterbury, Conn., *Q. prinoides,* H. F. Bassett, in Kinsey coll.

Fig. 346. *C. gemmula gemmula* agamic form *prinoides,* Richland, N.J., *Q. prinoides,* Kinsey coll.

Fig. 347. *C. pezomachoides erinacei* bisex. form *bicolens,* Glencoe, Ill., *Q. alba,* L. H. Weld, in Kinsey coll.

Fig. 348. *C. pezomachoides erinacei* agamic form *erinacei,* paratype, (Rockport?) Ohio, from H. F. Bassett coll., in U.S. Nat. Mus.



FIGS. 342-348. ALTERNATING GENERATIONS IN ACRASPIS

Differing as long-winged and short-winged species differ within the same subgenus.

SUBGENUS ACRASPIS

STRUCTURAL DETAILS

Fig. 349. Tarsal claw, *C. mellea carolina,* Richland, N.J., *Q. stellata,* Kinsey coll. Typical of Ashmead's group *Sphaeroteras.*

Fig. 350. Tarsal claw, *C. mellea compta,* paratype, Austin, Texas, *Q. stellata,* J. T. Patterson no. 138, in Kinsey coll. Claw less distinctly simple.

Fig. 351. *C. pezomachoides pezomachoides,* Richland, N.J. *Q. alba,* Kinsey coll. Toothed claw of the species which is type of *Acraspis.*

Figs. 352-353. Eggs, *C. pezomachoides erinacei.* Agamic form *erinacei* (fig. 352) and bisex. form *bicolens* (fig. 353). Redrawn after Triggerson.

FRONT WINGS

From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 354. *C. arida,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 355. *C. mellea compta,* paratype, Austin, Texas, *Q. stellata,* J. T. Patterson no. 138, in Kinsey coll.

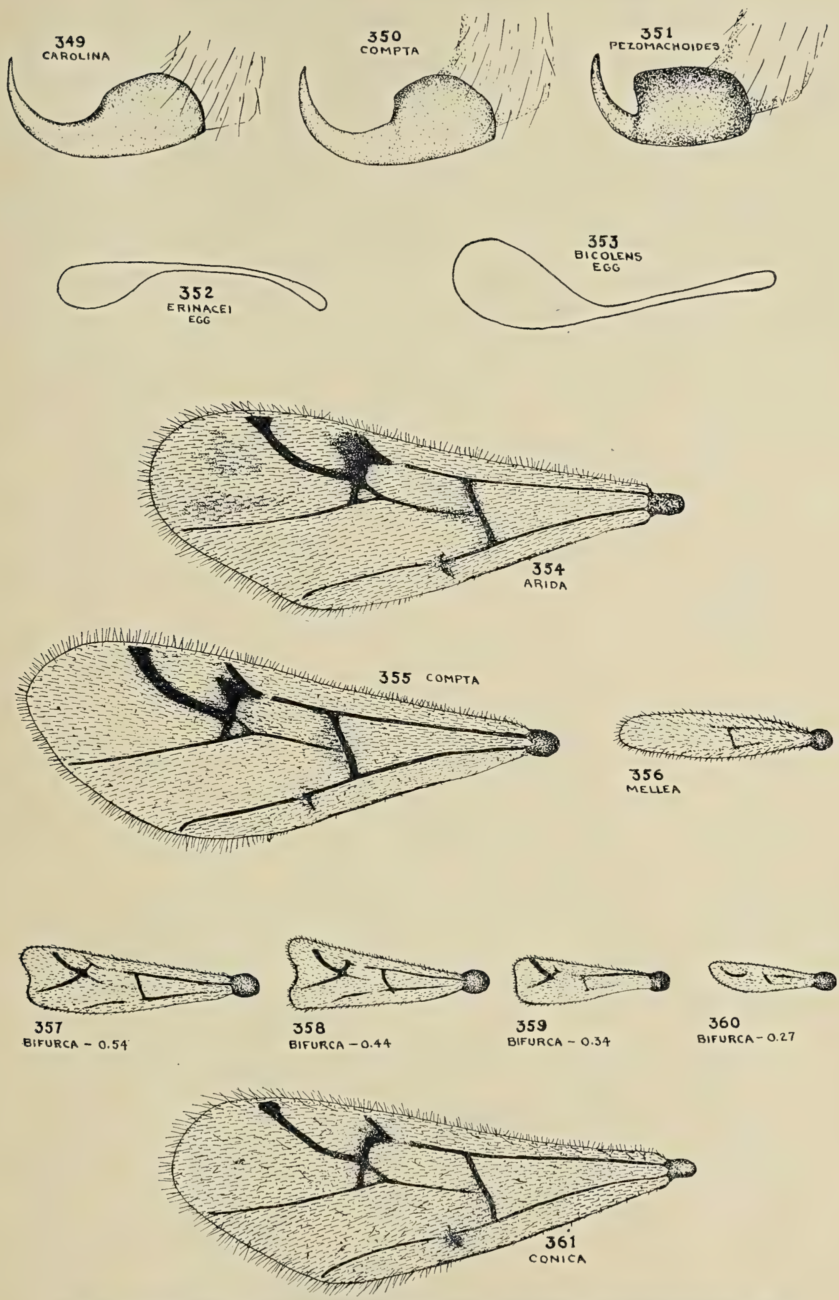
Fig. 356. *C. mellea mellea,* holotype, Jacksonville, Florida, *Q. stellata* var., W. H. Ashmead, in U.S. Nat. Mus.

Fig. 357. *C. mellea bifurca,* Fender, Georgia, *Q. floridana,* Kinsey coll. Wing-body ratio = 0.54.

Fig. 358. *C. mellea bifurca,* holotype, Picayune, Miss., *Q. stellata,* W. E. Smith, in Kinsey coll. Wing-body ratio = 0.44.

Figs. 359-360. *C. mellea bifurca,* paratypes, Picayune, Miss., *Q. stellata,* W. E. Smith, in Kinsey coll. Wing-body ratio = 0.34 (fig. 359) and 0.27 (fig. 360).

Fig. 361. *C. conica,* holotype, Globe, Ariz., *Q. grisea,* Kinsey coll.



FIGS. 349-361. STRUCTURES AND WING MUTATIONS IN ACRASPIS

Actively mutating forms (figs. 357-360), and a short-winged species (fig. 356) with a long-winged relative (fig. 355).

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FRONT WINGS, SUBGENUS ACRASPIS

From adults uniformly enlarged to 50. mm., so wing-body ratios may be compared by direct comparisons of wing drawings

Fig. 362. *C. villosa expositor,* paratype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 363. *C. villosa apache,* holotype, Globe, Arizona, *Q. grisea,* Kinsey coll. Reconstruction of part of venation, from damaged wing.

Fig. 364. *C. villosa alaria,* paratype, Colorado Springs, Colo., *Q. Gambelii,* J. H. Pollock, in Kinsey coll.

Fig. 365. *C. villosa villosa,* holotype, Ames, Iowa, *Q. macrocarpa,* C. P. Gillette, in U.S. Nat. Mus.

Fig. 366. *C. villosa calvescens,* holotype, Bountiful, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

Fig. 367. *C. villosa consocians,* holotype, Winfield, Kans., *Q. macrocarpa,* R. Voris, in Kinsey coll.

Fig. 368. *C. nubila russa,* Oracle, Ariz., *Q. arizonica,* Kinsey coll.

Fig. 369. *C. gemmula suspecta,* holotype, Bloomington, Ind., *Q. Michauxii,* C. M. Kinsey, in Kinsey coll.

Fig. 370. *C. gemmula fuscata,* holotype, Winfield, Kans. *Q. Mühlenbergii,* R. Voris, in Kinsey coll.

Fig. 371. *C. gemmula cruenta,* holotype, America, Ill., *Q. Michauxii,* Kinsey coll.

Fig. 372. *C. pezomachoides cincturata,* holotype, Colorado, C. F. Baker, in U.S. Nat. Mus.

Fig. 373. *C. pezomachoides ozark,* holotype, Arcadia, Mo., *Q. alba,* Kinsey coll.

Fig. 374. *C. pezomachoides wheeleri,* holotype, Bay City, Mich., *Q. alba,* Kinsey coll.

Fig. 375. *C. pezomachoides pezomachoides,* Eastville, Va., *Q. alba,* Kinsey coll.

Fig. 376. *C. pezomachoides derivatus,* holotype, 13 miles north of Troy, Alabama, *Q. alba,* Kinsey coll.

Fig. 377. *C. pezomachoides advena,* holotype, Oakdale, Tenn., *Q. alba,* Kinsey coll.

Fig. 378. *C. pezomachoides echinoides,* holotype, Jacksonville, Fla., *Q. bicolor,* W. H. Ashmead, in U.S. Nat. Mus.

Fig. 379. *C. hirta undulata,* holotype, Manitou, Colo., *Q. Gambelii,* C. P. Gillette, in U.S. Nat. Mus.

Fig. 380. *C. hirta packorum,* holotype, Bountiful, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

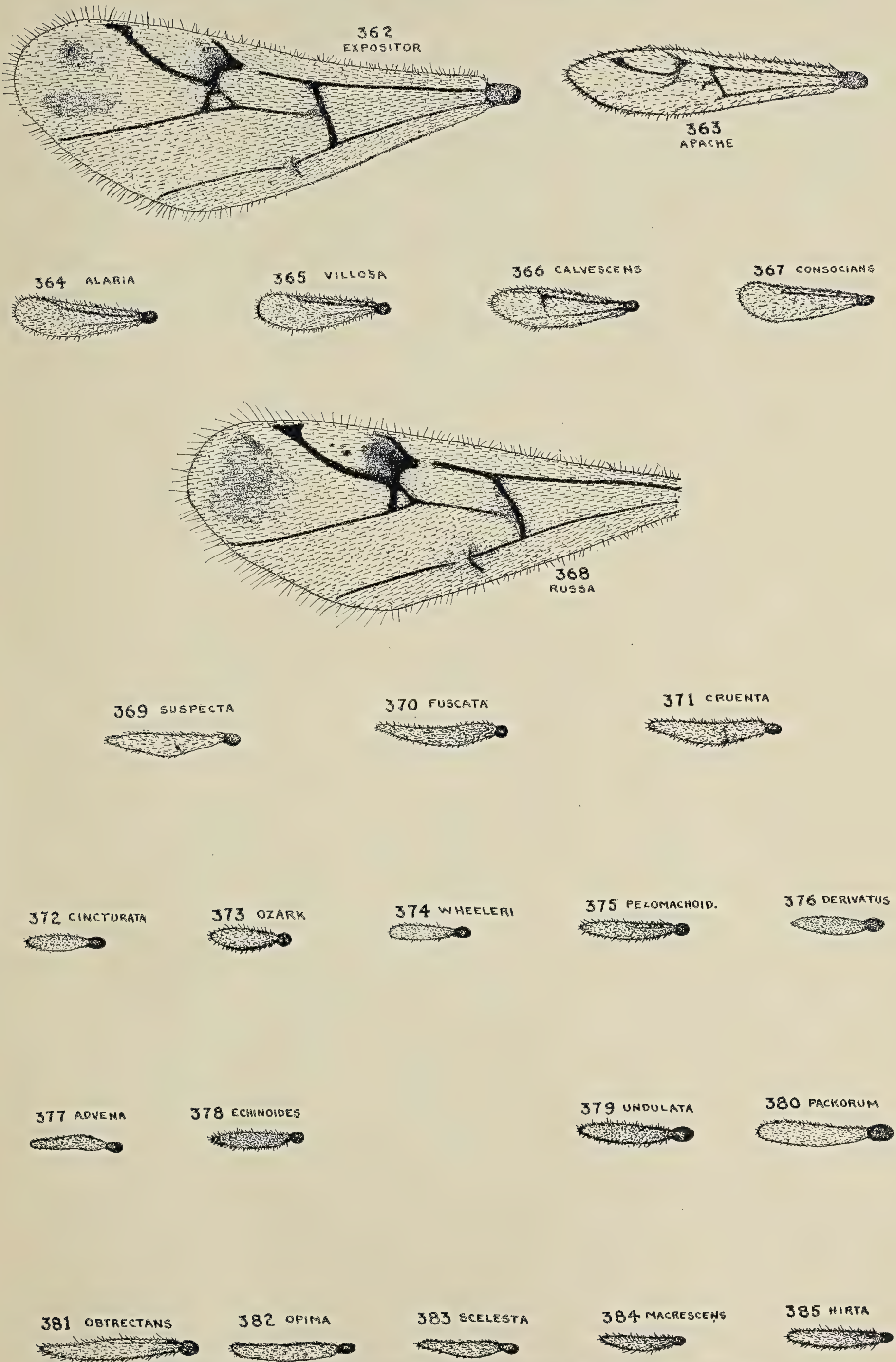
Fig. 381. *C. hirta obtrectans,* holotype, Austin, Texas., *Q. macrocarpa,* J. T. Patterson no. 136, in Kinsey coll.

Fig. 382. *C. hirta opima,* holotype, Seneca, Ill., *Q. macrocarpa,* Kinsey coll.

Fig. 383. *C. hirta scelesta,* holotype, Wayland, Mich., *Q. macrocarpa,* Kinsey coll.

Fig. 384. *C. hirta macrescens,* paratype of Bassett's *macrocarpae,* Rockport, Ohio, *Q. macrocarpa,* from H. F. Bassett coll., in Kinsey coll.

Fig. 385. *C. hirta hirta,* holotype, Waterbury, Conn., *Q. Prinus,* H. F. Bassett, in Phila. Acad.



FIGS. 362-385. WING MUTATION IN ACRASPIS

All short-winged species derived from long-winged, ancestral stocks.

NORMAL HYPOPYGIAL SPINE IN ACRASPIS

From adults uniformly enlarged to 150. mm., so sizes of spines may be compared by direct comparisons of drawings

Fig. 386. *C. mellea rydbergiana,* holotype, Las Vegas Hot Springs, N.M., *Q. rydbergiana,* T. D. A. Cockerell, in U.S. Nat. Mus.

Fig. 387. *C. mellea unica,* paratype, Ironton, Mo., *Q. stellata,* L. H. Weld, in Kinsey coll.

Fig. 388. *C. mellea compta,* paratype, Austin, Texas, *Q. stellata,* J. T. Patterson no. 138, in Kinsey coll.

Fig. 389. *C. mellea anceps,* paratype, Austin, Texas, *Q. breviloba,* J. T. Patterson no. 127, in Kinsey coll.

Fig. 390. *C. mellea bifurca,* holotype, Picayune, Miss., *Q. stellata,* W. E. Smith, in Kinsey coll.

Fig. 391. *C. mellea litigans,* holotype, Athens, Alabama, *Q. stellata,* Kinsey coll.

Fig. 392. *C. mellea concolor,* holotype, Bowling Green, Fla., *Q. minima,* Kinsey coll.

Fig. 393. *C. mellea mellea,* holotype, Jacksonville, Fla., *Q. stellata* var., W. H. Ashmead, in U.S. Nat. Mus.

Fig. 394. *C. mellea carolina,* Richland, N.J., *Q. stellata,* Kinsey coll.

Fig. 395. *C. mellea crassior,* holotype, Acworth, Georgia, *Q. stellata,* Kinsey coll.

Fig. 396. *C. mellea albicolens,* holotype, Madison, Georgia, *Q. alba,* Kinsey coll.

Fig. 397. *C. nubila nubila,* Santa Rita Mts., Ariz., *Q. arizonica,* Kinsey coll.

Fig. 398. *C. nubila russa,* Oracle, Ariz., *Q. arizonica,* Kinsey coll.

Fig. 399. *C. nubila incompta,* paratype, San Luis Potosi, Mexico, *Q. reticulata* (?), Ed. Palmer, in Kinsey coll.

Fig. 400. *C. villosa acraspiformis,* Kingston, N.M., *Q. grisea,* Kinsey coll.

Fig. 401. *C. villosa expositor,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

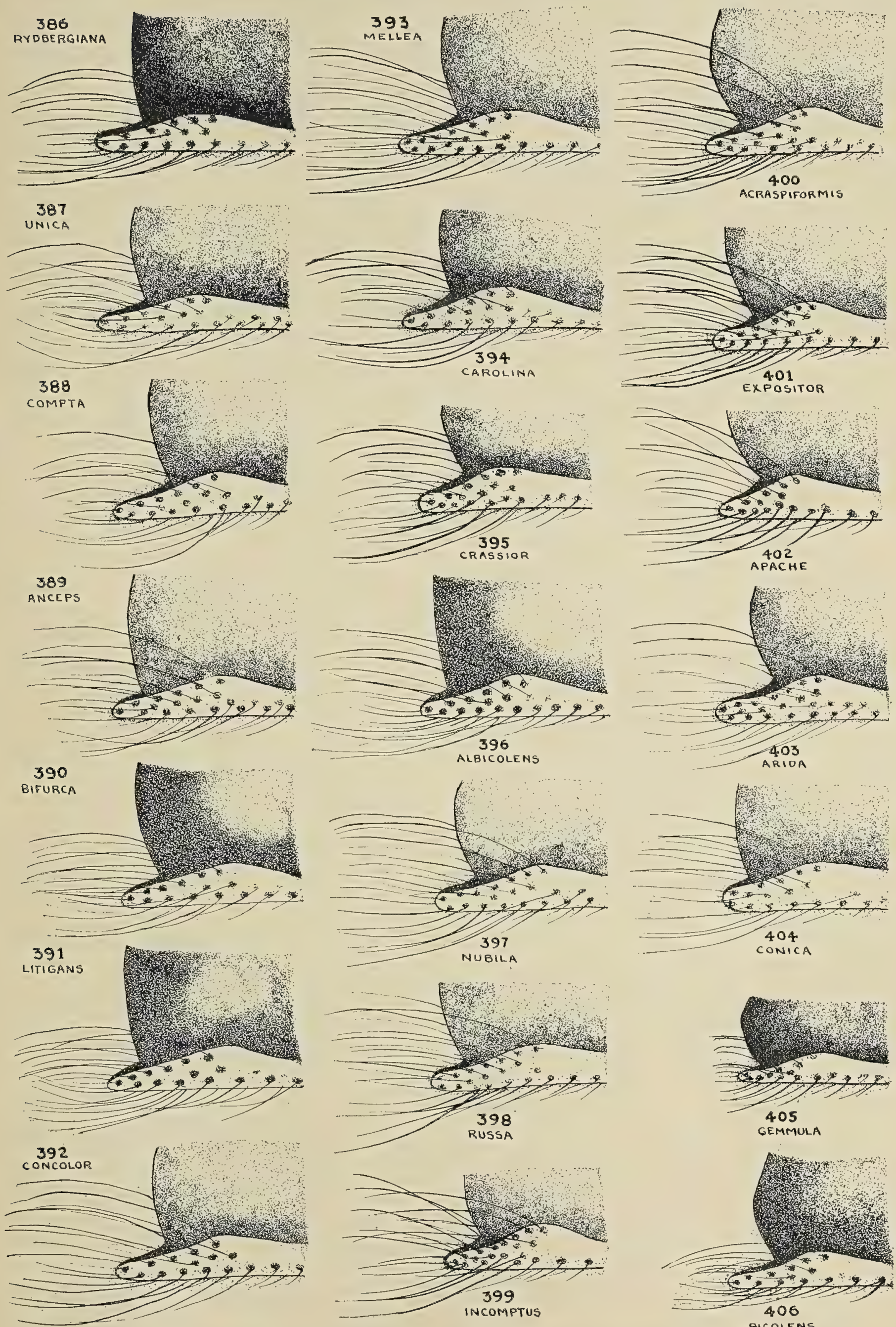
Fig. 402. *C. villosa apache,* holotype, Globe, Ariz., *Q. grisea,* Kinsey coll.

Fig. 403. *C. arida,* holotype, Alpine, Texas, *Q. grisea,* Kinsey coll.

Fig. 404. *C. conica,* holotype, Globe, Ariz., *Q. grisea,* Kinsey coll.

Fig. 405. *C. gemmula gemmula* bisex. form *gemmula,* paratype, Waterbury, Conn., *Q. prinoides,* H. F. Bassett, in Kinsey coll.

Fig. 406. *C. pezomachoides erinacei* bisex. form *bicolens,* holotype, Ravinia, Ill., *Q. alba,* L. H. Weld, in Mus. Comp. Zool.



FIGS. 386-406. NORMAL HYPOPYGIAL SPINE IN ACRASPIS

Found only in long-winged forms. Spine more slender in bisexual forms (figs. 405-406).

HYPOPYGIAL SPINES IN SHORT-WINGED ACRASPIS

From adults uniformly enlarged to 150. mm., so sizes of spines may be compared by direct comparisons of drawings

Fig. 407. *C. villosa alaria,* paratype, Colorado Springs, Colo., *Q. Gambelii,* J. H. Pollock, in Kinsey coll.

Fig. 408. *C. villosa calvescens,* holotype, Bountiful, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

Fig. 409. *C. villosa villosa,* holotype, Ames, Iowa, *Q. macrocarpa,* C. P. Gillette, in U.S. Nat. Mus.

Fig. 410. *C. villosa consocians,* holotype, Winfield, Kans., *Q. macrocarpa,* R. Voris, in Kinsey coll.

Fig. 411. *C. gemmula cruenta,* holotype, America, Ill., *Q. Michauxii,* Kinsey coll.

Fig. 412. *C. gemmula fuscata,* holotype, Winfield, Kans., *Q. Mühlenbergii,* R. Voris, in Kinsey coll.

Fig. 413. *C. gemmula suspecta,* holotype, Bloomington, Ind., *Q. Michauxii,* C. M. Kinsey, in Kinsey coll.

Fig. 414. *C. gemmula gemmula* agamic form *prinoides,* Richland, N.J., *Q. prinoides,* Kinsey coll.

Fig. 415. *C. pezomachoides cincturata,* holotype, Colorado, C. F. Baker, in U.S. Nat. Mus.

Fig. 416. *C. pezomachoides ozark,* holotype, Arcadia, Mo., *Q. alba,* Kinsey coll.

Fig. 417. *C. pezomachoides wheeleri,* holotype, Bay City, Mich., *Q. alba,* Kinsey coll.

Fig. 418. *C. pezomachoides pezomachoides,* Eastville, Va., *Q. alba,* Kinsey coll.

Fig. 419. *C. pezomachoides derivatus,* holotype, 13 miles north of Troy, Alabama, *Q. alba,* Kinsey coll.

Fig. 420. *C. pezomachoides erinacei,* paratype, (Rockport?) Ohio, from H. F. Bassett coll., in Kinsey coll.

Fig. 421. *C. pezomachoides advena,* holotype, Oakdale, Tenn., *Q. alba.* Kinsey coll.

Fig. 422. *C. pezomachoides echinoides,* holotype, Jacksonville, Fla., *Q. bicolor,* W. H. Ashmead, in U.S. Nat. Mus.

Fig. 423. *C. hirta undulata,* holotype, Manitou, Colo., *Q. Gambelii,* C. P. Gillette, in U.S. Nat. Mus.

Fig. 424. *C. hirta packorum,* holotype, Bountiful, Utah, *Q. utahensis,* B. and H. J. Pack, in Kinsey coll.

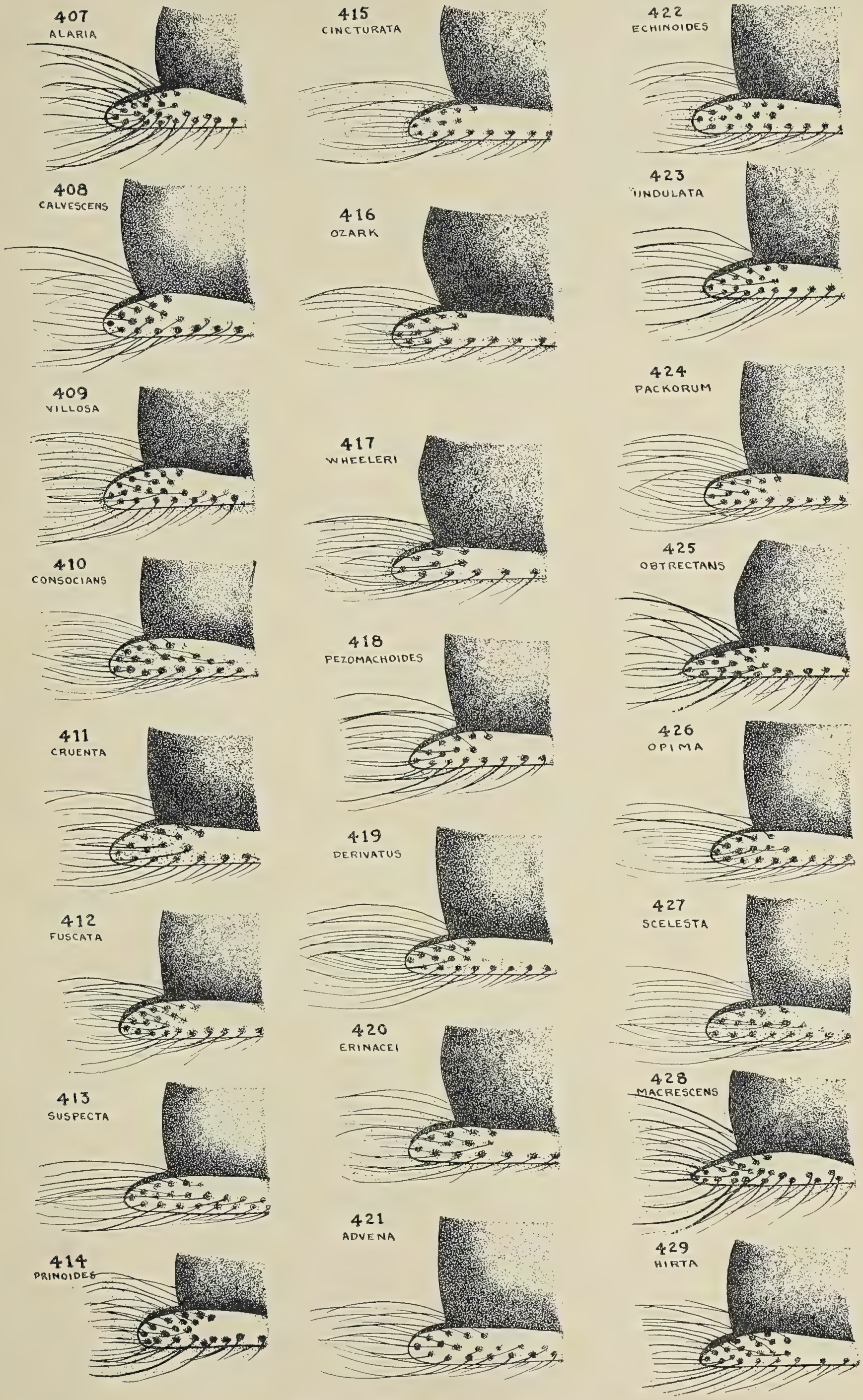
Fig. 425. *C. hirta obtrectans,* holotype, Austin, Texas, *Q. macrocarpa,* J. T. Patterson no. 136, in Kinsey coll.

Fig. 426. *C. hirta opima,* holotype, Seneca, Ill., *Q. macrocarpa,* Kinsey coll.

Fig. 427. *C. hirta scelesta,* holotype, Wayland, Mich., *Q. macrocarpa,* Kinsey coll.

Fig. 428. *C. hirta macrescens,* paratype of Bassett's *macrocarpae,* Rockport, Ohio, *Q. macrocarpa,* from H. F. Bassett coll., in Kinsey coll.

Fig. 429. *C. hirta hirta,* holotype, Waterbury, Conn., *Q. Prinus,* H. F. Bassett, in Phila. Acad.



FIGS. 407-429. HYPOPYGIAL SPINE IN SHORT-WINGED ACRASPIS

Uniformly modified in conjunction with wing mutation.

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Items of general biologic interest, and distributional data listed by states and under each species of *Quercus*, are included in this index. Names assigned to *Cynips* and the principal page references are in **bold face**; synonyms in *Cynips* are in italics.